Centre for Commercial Law Studies

Awaiting the support of the written description: defining the technical contribution in the emergence of early English patent law

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Submitted in partial fulfilment of the requirements of the Degree of Master of Philosophy
2018

Statement of originality

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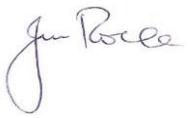

Date: 13 December, 2016

Acknowledgments

I wish to dedicate this thesis to my wife Gráinne and sons James, Mark and Eóin who have respectively been without a husband and father for much of the gestation of this work. Many Brownie points have been consumed but I could not have prevailed without their love, forbearance and continuous encouragement.
I also wish to thank my Mum and for her continuous promptings. In addition, I remember my Dad who passed away during the research and to thank him for bequeathing an interest in matters literary and scientific.

This work was supported by the Staff Development Fund of Athlone Institute of Technology, Athlone, Ireland and this is gratefully acknowledged.

I am especially grateful to my supervisors. Prof Johanna Gibson, Herschel Smith Professor of Intellectual Property Law at the Queen Mary Centre for Commercial Law Studies is warmly thanked for agreeing to champion my project proposal and involving me in the many activities she organised for the Queen Mary Intellectual Property Research Institute. I am and will remain above all, eternally thankful to Prof Phillip Johnson, Professor of Commercial Law at the Cardiff University Law School and recently of University College Dublin, who has encouraged me to approach, structure and deliver a thesis I could not have envisaged just a short few years ago. Thank you both so much for all the promptings, advice, encouragement and support.
I must additionally extend gratitude for the assistance most generously provided by Mr Malcolm Langley, Librarian of the Intellectual Property Archive at the Institute of Advanced Legal Studies and who was always ready to assist. I also wish to acknowledge the assistance of the staff at the National Archives, Kew.

The generous agreement for the use of the image of the King's Book of Bounty by the Board of Trinity College, Dublin is acknowledged.

I finally thank my examiners for giving of their time and expertise to assess this attempt to contribute to the history of early patent law.

Abstract

Technology had made but tentative advances under the aegis of oral communication with merely sporadic demands for a recognisably modern patent system until the late 1700s. Fixity of craft knowledge had a problematic upbringing with guilds propagating stasis under a collectivist encirclement of skills.

Emancipation from this feudalistic overhang was associated with mysteries often not tethered to a location; untied by sole-trading sometimes immigrant artisans including apothecaries, applied mathematicians and surgical practitioners, with the use of notebooks to question, record, and faithfully witness explanation and clinical experiences. These vernacular descriptions revealed an inheritable imperative to forego secrecy. Meanwhile, government attempts to administer the phenomenon of invention becoming a democratic asset required that the introducer, as well as the originator, be rewarded. The highly-skilled responded to this security, London's allure creating a polyglot conurbation, yet one where the utility of early formats of inventive output required but vague commitments to public education. Having finally exposed the inadequacies of oral information-transfer, the parallels of the advent of printing presses and the reach of faith, stimulated access to learned communications. Later, scientific literacy created a new appreciation of vulgar knowledge; this elevation also uncovering novel entrepreneurial chattels; individual property in everyday techniques. The jigsaw next required key visionaries: those who were technologically adept while simultaneously demanding written instruments to stipulate inventive space. The reaction of the Commons was to legislate against monopolies, a response insufficient to foster patents for invention.

The mosaic of language initiated a still later seismic shift in the description of scientific phenomena. Publication became the arc of progress through which new fraternities held sway as intellectual networks demanded the utensil of the hypothesis to interpret advances. Contemporaneously, the early adoption of some broad patents provided a realisation whereby, discriminating that which was truly momentous required disclosure of a full written description, the most significant part of which was to become the applicant's patent specification.

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Abbreviations

BL	British Library
Bull NP	*Buller's Law of Nisi Prius*
Carp Pat Cas	*Carpmael's Patent Cases*
CJ	House of Commons Journal
Co. Rep.	*Coke's King's Bench Reports*
Cro. Jac.	*Croke's Reports temp. Jac*
Dav Pat Cas	*Davies' Patent Cases*
EPC	European Patent Convention
ER	*English Reports*
EWHC	England & Wales High Court
FCA	Federal Court of Australia
FCAFC	Federal Court of Australia Full Court
FRS	Fellow of the Royal Society
Godbolt	*Godbolt's Reports*
H. Bl	*Henry Blackstone's Reports*
HMSO	Her Majesty's Stationery Office
HPC	*Hayward's Patent Cases*
JPOS	*Journal of the Patent & Trademark Office Society*
LQR	*Law Quarterly Review*
m.	Membrane
MD	Doctor of Medicine
M & W	*Meeson & Welsby's Exchequer Reports*
Moore	*Moore's Reports*
MSS	Manuscripts
MS Harley (or Harl.)	Harley Manuscript
MS Sloane	Sloane Manuscript
Noy	*Noy's Reports*
PA	Patents Act 1977
PP.	Parliamentary Papers
RP	*Rotuli Parliamentorum*
R. R.	*Revised Reports*
RPC	*Reports of Patent Cases*
Salk	*Salkeld's Reports*
SPD	State Papers Domestic
S. Ct.	Supreme Court (United States)
TNA	The National Archives, Kew
UCL	University College London
U.S.	United States
USC	United States Code
Web Pat Cas	*Webster's Patent Cases*
WIPO	World Intellectual Property Organisation
Y & CC	*Young & Collyer's Chancery Cases*

Chapter 1

Setting the Scene

No matter how attractive the emancipatory appeal of a digitised, organic future may be, because the concepts which are under dispute and the language within which these arguments are posed are mediated by the past, even the most radical of accounts remain indebted to the tradition from which they are trying to escape.

> Sherman, B. Bently, L.
> The Making of Modern Intellectual Property Law, Cambridge: University Press, 1999, p. 2.

1 Setting the scene

What, if any, was the form of the early written description?

The legacy of a patented innovation in technology can be accessed at any time through the vista of the written description. Such facile diffusion through an interrogated specification can carve out an unrealistic expectation for a linear transfer of intellectual property. Technical memory however had a more problematic upbringing. Initially grounded in oral tradition, the circulatory system of knowledge only commenced a substantial flow once the availability of printed treatises and books induced people to read regularly. In England, prior to this activation there were but erratic trickles of technological development, with some tides of technical know-how requiring several pulses of inducement before an exploitable inheritance became available. The ending of this early monopoly of access to thought and assimilation of understanding accelerated the dissemination of methods with a capability to define crafts-based knowledge.

Through the medium of *literae patentæs* (open letters) the first patent for invention in the country was granted for the manufacture of coloured glass, yet this gift of technology failed to embed; for there were but vague expectations and an ill-defined mechanism for how a technology transfer was to occur. Such patents were not solely for inventive activity; they were obtainable for the first to introduce any industry *into the kingdom*. A singular problem was that a gap in the repository of national skills was being papered over through such executions of the monarch's prerogative. With no fixity of remembrance there remained an unsatisfied inventory, for there was no requirement for a written description in early English patent law. On the other hand, once the printing-press arrived, published matter could hardly have failed to usurp in a more spectacular fashion.

What is the need for an analysis of the written description?

Patent litigation primarily features embodiments of novel products or related processes derived from human intellectual endeavour. Currently, the pillar-stone that upholds the mutual balance of interests between the patentee and society is that part of the patent application termed the specification. Therein are to be recorded a

description of the invention, the claims (supported by the description) to what has been invented; a clear and concise account of what a monopoly is sought for, any drawings relevant to these requirements; and an abstract.[1] Should the criteria for patentability be met, the payback for the inventor upon publication of the details will be a time-limited negative right to deny others from making or using the invention.

There has been a continuum of commentary[2] on the exact trigger for the later eighteenth century demand for an adequate description of the novelty underpinning a patent for invention. Such stipulations have been recognised as the fulcrum upon which the validity of the enticement for the inventor resides, with any imbalance likely to unhinge the reciprocity that had become alloyed into the entire examination of a claimed inventive space. The mosaic of anticipation[3] would now define what actually constituted viable territory for carving out such a liberty in a previously unexplored technical arena and how this should be expressed.

Somewhat more opaque however, are the fogs of time, trigger-factors and inputs stretching back to the reign of Edward I when the insufficiency of technical attainments was such, that isolation on a small island off Europe was first recognised as an inelastic barrier which required a new lubricant to stimulate progress. The stranger would need repeated bouts of enticement, but the requisite skills, for significant crafts' activities, had particular difficulty in bonding to the repertoire of the native artisans.

The lens of this study will come into focus upon the stimulus provided by the emergence of an efficiency of English, coupled to the decline in status of the craft-guilds. This recession came under the cusp of an increasing societal literacy, partly stimulated and then irrevocably reinforced, by the output of the new invention of printing. An earlier parallel of this sequence had occurred in Venice but its durability proved more stable in an England increasingly finding room for personal expression and recourse to parliamentary representation. The Achilles'

[1] Patents Act 1977 (PA), s 14 (5) (a). PA s 14 (5) (c). European Patent Convention (EPC) (1973, revised 2000) Art. 84.
[2] The analysis in this thesis begins with early recordings of technique as guilds fragmented; transferable influences migrating from abroad; the etymology of vernacular; some drivers of incremental technical entrepreneurship & endeavour favoured in legislation; and the roots of scientific reason are made more secure.
[3] *Liardet* v *Johnson*, GB 1040 [1773]; (1778) Bull NP 76; 1 Web Pat Cas 53; 1 Carp Pat Cas 35.

heel for each of economic equilibrium and technical advance within England was an overdependence on one product (wool) and an undersupply of wood, but such shackles were to be eliminated, in part due to advances in scientific curiosity and an increasing capability of accessing new supplies of fuel. Notions of dissent centred on and found expression in its more extreme forms through the migration of Calvinist ideologies to America but, in its less confrontational mode, the Protestant ethic and spirit of capitalism coupled with an erosion of the prerogative, sparked new synapses of inventive activity.

The significance of the research

This thesis makes a contribution through analysis of the separation of collectivist and individual learning and the latter's convergence through the media of: a formalisation of linguistic standards, experimentation in note-taking and cross-referencing, legislative necessity, and the role of the common scientist in the early promulgation and satisfaction of the written description in patent law.

As the touchstone for humankind's innate creativity, an educated understanding is the prerequisite behind the innovative embodiments expressed in the disclosure of an invention. This has been an exceptionally durable construct and has found its ultimate expression in the requirement that the patent application needs to incorporate such a full written description that it may be replicated by that euphemistic individual, the (ordinary) person skilled in the art.[4] Such a description entails a written disclosure which enables examination of the invention's suitability for a patent. It is no accident that such descriptions have been equated with scientific or technical papers in that: 'they explain what has been created, the problems that the invention solves, why it is important, and how the invention differs from what has been created before.'[5] Earlier, as the reading public magnified towards the close of the Middle Ages, the tethers of guild control were loosened as the capacity of those mechanical processes for a more automated reproduction of documentation, printing, became commercially efficient. This was a seminal moment, one which moulded a kinesic activation of written technology. My thesis shows how the written description as a central item of patent law was

[4] PA s 3. EPC Art.56. See also 35 USC §103.
[5] Bently, L. Sherman, B. *Intellectual Property Law,* 4th edn. Oxford: University Press, 2014, p. 409.

delayed for so long. It will also explain however why the introduction of the printing-press was not the sole component of this construct for diffusion.

The significance of a mechanism for such enabling features is not a new phenomenon. They emerged certainly as the patentee of the seventeenth century needed to stake-out their inventive space or perhaps circumvent that of a rival. The requirement for this judicial (as opposed to enacted) construct was inevitable once science, language, ambition and freedom fused at the crest of an accommodating plane of earlier benign legislation.

The role of this thesis is to apply a new awareness of the significant longevity leading to this new liberalism; to enter a gap in understanding and once there, to interrogate the inputs to the evolution of this union.

Explanation and structure of the thesis

Each chapter provides an internalised analysis of observations recorded during the era in hand and subsequent emerging literature, all against the background of legislative drivers.

Knowledge dissemination directed events and no little conflict during the reign of Elizabeth. Chapter 2 reflects the exploitable stasis, indeed guild-derived hangover, behind the ability of the well connected to appropriate, within the arena of technical instruction, an egregious influence which proved unsustainable. Organic improvements in the application of crafts' skills notwithstanding, how this was spliced to a reality of increasing guild dilution may be substantially attributed to the altering equilibrium in commercial activity driven by increasing demand for fuel and from those overseas markets seeking wool and tin. The irony was that, concomitant with the increasing penetration of trade, many crafts had lost influence, faltering in the tailwinds of the merchants. In a curious juxtaposition, one profession, the physicians, operating through training and education using a restricted number of non-contestable, set books, was to find itself partly usurped by the translational approaches of the emergent surgeons; the latter's practical craft necessitating a faithful witnessing of increasingly ambitious treatments, recorded for subsequent personal use or for their followers and heirs. For some of these scribes, an eye on a legacy of prestige was an acceptable side-effect. A transformative effect in technical pedagogy had occurred. Eventually, mirroring

their nation's mathematicians, the English physicians were corralled into a organised framework under the influence of Thomas Linacre, physician to Henry VII and Henry VIII and strikingly, an interdisciplinary contemporary of Aldus and also a forerunning Padovan alumnus to the influential anatomist Vesalius.

The newly evolved apparatus of a homogenous vernacular opened new vaults of ambition. For, while earlier centuries had sustained a model of a restrictive intergenerational-transfer of technical knowledge thanks to an accumulated repository of behaviour and understanding, the opening-out provided by the printed word was quite profound. This was especially true in an expanding society of unusual linguistic homogeneity and legal coherence[6] now underpinned by increasing accessibility to public records, the innovations of the common-law system of pleading, and the sanctity of mechanisms to secure the authenticity of the regime's seals. A faithful recording of the cumulative character of techniques was now in hand.

As an early warning for the last of the Tudors and the following Stuarts, how the ripples of societal cohesion could be smoothed, or otherwise rendered turbulent, is also described in this chapter; pointedly from the manner in which rulers 'distributed their favours'[7] among which were commercial monopolies. Although an earlier event, it was through a disregard of this principle that Henry VI forfeited the influence necessary 'to retain the sceptre of his authority'.[8] The omens might have been foretold, but as the seventeenth century was dawning, the odium of monopoly could no longer be dissipated across a moribund populace. Once more the sense of medical networking exerting an influence through the writings of erudite practitioners had a role in seeking to answer new interest in experimentation. The political clarion was for a parliament for all men; nevertheless, in the legislative response, the 1624 Statute of Monopolies, a reluctant partition emerged; henceforth, invention was theoretically a separate arena.

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[6] Termed the: 'growing status of law as a symbol of order in society.' Britnell, R. H. *The Commercialisation of English Society, 1000-1500*, Manchester: University Press, 1996, p. 231. Also: Beckerman, J. S. Procedural Innovation and Institutional Change in Medieval English Manorial Courts, *Law and History Review*, 10, 2, 1992, pp. 197-252.

[7] Cherry, M. 'The Courtenay Earls of Devon: The Formation and Disintegration of a Late Medieval Aristocratic Affinity', *Southern History*, 1, 1979, pp. 71-97 at 90-94, 97.

[8] Payling, S. J. *Political Society in Lancastrian England: The Greater Gentry of Nottinghamshire*, Oxford: Clarendon Press, 1991, pp. 152-56.

Simultaneously, and reflecting what had transpired to *their* coherence and hegemony with the failure of traditional guilds to dam the breech that knowledge diffusion was to bring, the increasingly specialised sciences sheltering under the umbrella of therapeutics emerged. One incipient stimulus being the earlier written technical descriptions of innovative activity by pioneering surgeons such as John of Arderne and John Bradmore[9] and their successors; and still later, the compilations of botanicals' descriptions that soon triggered written specifications for active substances in the nascent pharmacopoeial monographs. At the cusp of the seventeenth century, there were now, thanks to an ease of integration of applied mathematical and technical proficiencies and visionaries such as Sturtevant, irrevocable eruptions in the form of an increasing logic in the concept of experiment and invention, format of illustration and geometric detail. The chapter shows how this was an essential prerequisite for the medium of defining the specifics of an invention.

Chapter 3 seeks to interpret and reposition the intellectual upsurge of the Restoration era with the requirement in the following century for compliance with the new repository of the patent claims. Henceforth, the expectation of the inventor was that s/he would be required to fulfil the mandate of submitting a full description of the invention seeking the protection of the state. This study is conducted through the prism of early recordings made at the first laboratory benches, the homes of the curious; how this prompted the scientific method; an emergence anchored to the nascent Royal Society, and how this body treated and promulgated technical challenges, often nautical, of a surprising potency. Soon the Dissenters as scientists in the Midlands; and their favoured illiberal pursuits, propelled, though not necessarily steered innovation, before magnifying the benefits of access to and success at harnessing increasing supplies of coal. Through the authority of experiment, the scriptural concept of the Royal Society was such that it paved the road for a new mechanism for reporting the fruits of entrepreneurial endeavour and curiosity. The scientific demonstration was for a time in vogue, and while the scientific ideas behind it became: 'common property and changed the basic modes of thought, of the entire literate community of

[9] The former is particularly noted for the clarity of his illustrations; the latter is famous for successfully treating Henry V's facial injuries (as a prince) but was equally adept at recording the details of his procedures.

England'[10] the greater legacy was that the tentacles of basic and technological endeavour had a new outlet, the scientific journal. The inputs for how an invention was to be fully described were at last in place.

Books were never more vital but so too was speed of promulgation; the concept of self-promotion through a written description was now the bright radiance of Enlightenment, but in reality had as its source the original recordings of the glassworker Neri in Italy and the English surgeon, Bradmore. Such individualistic efforts were a form of attempt to appeal to posterity, yet minted a cumulative vault of systematic prior art which could only have succeeded as the suffocation of the feudalistic prerogative finally evaporated.

So the history if not tumult of the period spanning 1300-1650, it is contended here, heralded, as collectivism unravelled to displace the privileges of the craft-guilds, a particularly abundant harvest of national policy responses which facilitated England becoming the territory from which first materialised the formal expression of how patents for invention were to be defined, emerged.

[10] Shapiro, B. J. Law and Sciences in Seventeenth-Century England, *Stanford Law Review*, 21, 1969, pp. 727-66 at 728.

Chapter 2

Written Testaments Inform the Political Moment of Letters Patent for Inventions

Our Booke cases are the best proofe of what the law is.

Sir Edward Coke
2 Co. Litt. 254a.

2. Written testaments inform the political moment of letters patent for inventions

2.1 Introduction

In the absence of a formalised system for fostering innovation there remained a curious, yet ultimately unsurprising hiatus in the award of licences for inventive activities in England subsequent to the early letters-patent from the 1440s. For during the sixteenth and seventeenth centuries, the number of privileges so awarded for defining a recipient's inventive space, were extremely limited. This chapter now sets out the wider historical and cultural focus stimulated by access to the printed word and demonstrates nevertheless how this literary advance sat comfortably with new technology-themed texts in their pulling up of long-entrenched roots of thought. Though no longer embarrassed by history, such a tardy transformation from the rational to the experimental now became associated with embryonic developments in specifying the outputs of inventive activity either side of the enactment of the Statute of Monopolies. Contemporaneously, the attraction of England to foreign-born artisans reseeded a formalised system which created space in the Statute for the exception of inventions. In the meantime, tensions persisted as the last of the Tudors and the early Stuarts presided over a series of monopoly protections that were frequently industry-wide. Awarded under the Great Seal, many had little to do with enticing a new trade to the realm, never mind reward innovation or crucially, provide for an effective legacy from these grants in the form of a written description for inventions for the benefit of the populace. This would not do for a people who were increasingly literate and comfortable with a newfound freedom of thought, both elements fertilising their critical faculties and in turn reflected in their access to parliamentary representation and also recourse to the law. Thus was laid an oblique foundation for the later stipulations for defining the scientific advances underpinning a claimed invention.

2.2 Metamorphoses of technical communications

2.2.1 The printed word continues its colonisation

The era of chirographic manuscript duplication, although managing to co-exist for a time, was ultimately to succumb to the art and craft of printing. For example, the notion that manuscript book acquisition might sustain as the preserve of the wealthy[1] had been, for urbanised, university-educated physicians, been fraying at the edges during the fourteenth and fifteenth centuries and had gone into terminal decline by the sixteenth century.[2] A key decade for this thesis is the 1440s; it intrudes further now. The matter of whether Gutenberg *circa* 1447-50 or Coster in 1440 had priority in the implementation of the steps leading to the first use of movable type[3] is academic, yet there were additional revolutions vital to early efforts at efficient pedagogical dissemination of technique and associated implement depiction.

The frontiers for those budding technologists, who sought to understand and effectively communicate about their environment, were described by the Elizabethan mathematician John Dee (1527-1608) as: '*it* (natural philosophy) *proceedeth by Experiences…and also putteth the Conclusions themselves in Experience.*'[4] In this Dee was articulating, from personal familiarity, that rather than (as is sometimes assumed) eschewing the enlightenment of the Renaissance, England was home to several crucial demographics, who thanks to their proclivity to question and record, remain central to this theory. For, there endures the irrefutable fact that the traceable strides (vernacularism excepted) of the era come into sharp relief on the sciences of applied mathematics, astronomy and anatomy. Not within the modern scope of patentable subject-matter, these were however foregrounding technological advances, only sustainable through written descriptions for receptive, expanding audiences. The coincidence of printing was the perfect stimulant to new allegiances and novel approaches.

[1] Bell, H. E. The Price of Books in Medieval England, *Library*, 4th series, 1936, 17, pp. 313-32 at 332.
[2] Getz, F. M. Gilbertus Anglicus Anglicized, *Medical History*, 26, 1982, pp. 436-42 at 437.
[3] Van der Linde, A. *The Haarlem Legend of the Invention of Printing*, London: Blade, East & Blades, 1871, p. 68.
[4] Dee, M. J. *Elements of Geometrie*, London: John Day, 1570, preface.

2.2.2 Telescopic sights

2.2.2.1 Bringing home the early Bacon

Firstly, xylographic accompaniments would supplement the conveyance of written thought from this epoch, accelerating the displacement of oral communication as the default medium of education. Another consequence was that the traditional transcribers of school books and university disputations were consigned to a lower, eroding rank.

Key drivers in this printed, pioneering role as emissaries for the future furnishing of scientific advances, were: the Western innovators of mathematics, the science with the oldest history; now increasingly associated with navigation, and through its umbilical link with ordnance, the formulators of granulated gunpowder and the engineers of artillery casting and stronghold fortification.[5] The needs are simply exemplified, at this dawn of printing, in a manuscript compiled in France for Edward IV, which included strikingly beautiful illustration of citadel and cannon.[6] Yet the artistic merit of the depiction would convey little of transferable knowledge of calibre and effectiveness. Measurement and the scale of its representation needed an alternative perspective only accessible from the fountainheads of quantity and space.

A necessary accompaniment was the stimulus provided by a need to faithfully record experiments. Later becoming second nature for many from the seventeenth century; that this was not a trivial pursuit at this earlier juncture is underwritten by the realisation that science, indeed English technological pursuits, had been here previously. Roger Bacon (*ca*. 1214-94) had been an outstanding experimentalist as confirmed by his (and his master Robert Grossesteste's *ca*. 1175-1253) endeavours with magnifying lenses; his researches with gunpowder and the compass, and his thesis that the ideal student knows science through: 'experiments and alchemy and medicines…' His timing was unfortunate; as such correlations during the terminal years of the Crusades were easily associated with heresy. He was imprisoned and less than two decades after his death, Pope John

[5] See Acontius, *infra*.
[6] BL Royal MS 14 E IV, *Chroniques d'Angleterre*, 1470-80, f.23r.

XXII outlawed alchemy (1317).[7] Orthodoxy was thus preserved in the form of the Aristotelian system, but could not *now* survive those who, aided by printing, would render staid perspectives increasingly redundant. For example, medieval mechanics quickly faced obsolescence as improvements in cannon-casting required new experimental and mathematical approaches to validate the engineering of gunnery (see Bourne, below). Ironically, Bacon's work, leading to the 'Italian' invention of spectacles, paved the way for Murano glass-working lens-makers to lay a path to enhanced visual acuity for scholars and the subsequent death-knell of no-longer-necessary, large letterings. The page, indeed the book, was starting to open ever wider in its accommodation of technical descriptions.

2.2.2.2 A matter of Recorde

Being integral to an individual's learning, enhanced access to reading increased self-awareness; there were consequent eruptions as the domain of the written word displaced the realm of spoken instruction. Mathematics, perhaps the poor relation until now, also saw texts delivered. Polymath Robert Recorde (1510-58) physician to Edward VI and Queen Mary, had introduced the symbols + and – in 1540 and = in 1557 for the first time; certainly connected developments which would thereafter allow scientists to describe the world in an increasingly accurate manner.[8] *The* noteworthy English mathematician of his era,[9] it is ironic that one assessment states that 'his performances were slight, being largely elementary treatises to teach the uninformed.' Undoubtedly unappreciated, he preferred 'a simple plaine proofe manifest to all men.'[10]

2.2.2.3 Geometric progressions

Thomas Digges' (1546-1595) output of a redrafted *Prognostication Everlasting* (1576 and now including a treatment of navigation)[11] became a clarion for an

[7] Fyrth, H. J. Goldsmith, M. *Science, History and Technology, Book I, A.D. 800 to the 1840s*, London: Cassell & Company, 1965, p. 18.
[8] Gribbin J. *Science A History 1543-2001.* London: Penguin Press, 2002, p. 107.
[9] Recorde also filled the role of surveyor of mines (*infra*).
[10] Jones, R. F. *Ancients and Moderns*, 2nd edn. St. Louis: Washington University, 1961 p. 10.
[11] Digges, L. *A Prognostication of right good effect…*, London: T. Gemini, 1555.

advanced Copernican model of the universe, a thesis, ironically of suspicion for the Vatican, but accordingly, well received in England.[12] This is a key distinction, for as will be affirmed later, English physical sciences were by now, no longer in thrall to the dogma of Aristotelian precepts which were to clutter thought on the mainland of Europe. So the restraint of Continental Catholic obduracy was never the impediment that it might have been under a different relationship with Rome.

Thomas meanwhile had been raised by his guardian, the aforementioned Dee, who possessed an omniscient library, a fortuitous stimulant for the aspirant junior mathematician. This exceptional (the country's largest) collection of 4,000 volumes was made accessible; clients included Cecil, Lord Burghley and the queen. This accumulation of knowledge was the honey pot for practitioners which gave rise to the country's earliest scientific academy. Dee also collected scientific instruments essential for generating observations worthy of recording and describing. His endowments, incorporating practical applications of geometry and astronomy, thus informed Cecil's appetite for maritime expansion and crucially here, almost despite his elitist status (being a foundation Fellow of Trinity College) the impact of his Euclidian exposition upon: '*young men of the middle class, sons of tradesmen and craftsmen, was very great, setting out the ways in which geometry could advance technique and foster inventions*.'[13]

2.2.2.4 An origin of the species

A separate, yet parallel strand, were the portrayers of medical treatments and associated depicters of herbals. Each had a pioneering role in providing for an augmented availability of technical information. Yet there were still some constraints. One estimate suggests there were just sixty university-trained physicians in the country during the fifteenth century.[14] Up to now these institutions were both Church-based and oriented in perspective. Medical studies continued to be linked with theology; also the university towns of Oxford and Cambridge were comparatively small compared to their Continental peers. In the

[12] The model was also opposed by northern European Protestant churches.
[13] Taylor, E. G. R. in: Fauvel, J. Gray, J. (eds.) *The History of Mathematics*, Basingstoke: Open University, 1987, p. 288.
[14] Robbins, R. H. Medical Manuscripts in Middle English, *Speculum*, 45, 3, 1970, pp. 393-415 at 408.

absence of critical mass reputations had not yet been established. Furthermore, the curriculum was 'conservative, even reactionary.'[15] An early bequest from Humphrey, Duke of Gloucester, to Oxford comprised of manuscripts not intended to be of historical import *per se*, but rather those anticipated never to go out of date.

Unsurprisingly, in the face of such conservatism there remains a considerable catalogue of manuscripts after 1450 including one from William Hattecliffe, physician to Henry VI. Some from non-graduates such as monastic infirmary apprentices, the medieval 'leech' are also known. Nevertheless, while traditional guilds and it appears those with responsibility for the education of physicians had by now exhausted their innovatory canon, a subtle shift, one not inconvenienced by xylographic support to new treatises, was tentatively unfolding. In tandem with any eligible, early entries to a verifiable cataloguing of medical incunabula therefore there was now liberation from the anaesthesia of mind presided over by the dominant Ancients (Galen and Aristotle) with the progression towards metallotypography. This re-arrangement would be sufficient to achieve a considerable effect, yet an additional layer in the emerging sequence was forthcoming *via* the fine detail realisable from pre-photographic processes of illustration.

Although capable of re-use, the woodcut, that basis of image depiction, was liable to catastrophic damage. As established by Dürer, metal, whose fidelity of reproduction also presented a more durable alternative to the delivery of a printed illustration, was more difficult to craft. It was however the optimum mode for repeat use. Although not essential for small runs, with book printing of *popular* texts it would soon come into its own.

An early siren for technical illustration had been Hieronymus Brunschweig (*ca*.1450-*ca*.1512) whose speciality was description of scientific instruments, in particular implements for incisions. Although featuring process descriptions, his outputs were in the format of memory prompts, yet to evolve into mature detail.[16] At first glance this may appear a delinquent step backwards to manuscripts of an earlier century. Not so, for what had changed was that the introduction of these

[15] Voigts, L. E. McVaugh, M. R. A Latin Technical Phlebotomy and Its Middle English Translation, *Transactions of the American Philosophy Society*, 74, 2, 1984, pp. 1-69 at 14.
[16] Tebeaux, E. *The Emergence of a Tradition*: *Technical Writing in the English Renaissance, 1475-1640*, Amityville: Baywood, 1997, pp. 198-201 on: von Braunschweig, H. *The Noble Experyence of the Vertuous Handy Warke of Surgeri*, London: 1525.

woodcut-derived graphical representations resulted in descriptions of high quality visual appeal. Significantly, the drier currency of the *Articella*,[17] the great medieval compendium of medicine between the 13th and 16th centuries, declined after 1530.[18]

For the consumer of new texts there was the emerging reality that the previous maverick approach permitted by non-standardised manuscript books and their imposition of a unity of contents only through the holder's experience and needs, was no more.[19] Annotations might be added, but the printed matter imposed its own regularity and congruity. Furthermore, in tandem with printed book provision, a further innovation on the page was realised; the utilisation of virgin space as the need for word density reduced, increasingly assisted the process of understanding for otherwise complex, technical information.

2.2.3 Physic steps up

2.2.3.1 A reorganisation of thought

England, perhaps due to the 'unsettled state of physic as a science'[20] and the attendant late onset of a sufficiency of eligible members capable of sustaining the 1518 incorporation of the Royal College of Physicians, remained a bastion of Galen. One record which attests to the shackles on physicians confirms that during the reigns of Henry VI through Henry VIII there were no fixed allowances for doctors at court. In contrast to this system of reward or honorarium paid at the conclusion of an illness, the apothecary was more secure, being remunerated in terms of legal demand.[21] The lesson may not have been lost, for, the inauguration of the College, as personified by founder and classical scholar Thomas Linacre (1460-1524), physician to Henry VII and Henry VIII, *via* his translation of this Ancient's *On the Natural Faculties*, was a scientific advance in itself, for it heralded the displacement of old learning with a new appetite. Like Chaucer decades earlier, Linacre had been required to represent his country in Italy. He

[17] 'Little Art of Medicine', a collection of treatises primarily Galenic in its aspect.
[18] French, R. *William Harvey's Natural Philosophy*, Cambridge: University Press, 2008, p. 134.
[19] Clanchy, M. T. *From Memory to Written Record*: [England 1066-1307], Chichester: Wiley-Blackwell 3rd ed., 2013, p. 85.
[20] Johnson, J. N. *The Life of Thomas Linacre*, London: Edward Lumley, 1835, pp. 161-67.
[21] *Ibid*.

however, studied and qualified in Padua, and also subscribed to the New Academy of his printer friend Aldus.[22]

Although also appearing a retrograde position in that the Ancients continued to be accommodated, Linacre's translation was a cover for something more pertinent to the description of innovations. Mirroring Chaucer, he had become a diplomat of the mind and was convinced that the Latin Vulgate had become corrupted over the centuries. For things were now moving fast. There followed, in quick succession, the Act of Supremacy[23] of 1534 and Royal Injunctions of the following year. Perhaps not so ambitious in conception, but the harvest drawn down represented an intellectual pincer in that ecclesiastical authority lost ground in the universities, being replaced by medicine (as per Linacre's promptings) mathematics and classics. Unlike the other two, the latter does not strike as a discipline especially germane to descriptions of technology, but undeniably facilitated outputs such as the 'King Edward's Grammar'[24] the foundational formalising of the conjugation of verbs and the gender of nouns; all future essential components of a precision-laden mode of written technical communication.

These were steady progressions for English empiricists yet demanded a major increment of innovation in order for technical and scientific education to rise further. It arrived, with the academic appointment, also to Padua, just as physicians were first exposed to dissection, in the person of Andreas Vesalius (1514-64). Initially accessing cadavers so as to advance Galen's dissection strategies (constrained to animals by social norms) and then responding to the complexity of the human body,[25] Vesalius, after composing the first illustrations specifically designed for students, then crafted plates of important anatomical features designed to be superimposed on larger, figural woodcuts. His vast masterpiece[26] the *Fabrica*, being firstly a systematic treatment incorporating an index and lettered legends, crossed the Rubicon in highlighting that 'the eye was preferable to authority'.[27] As

[22] Lowry, M. J. C. The New Academy of Aldus Manutius: a Renaissance Dream, *Bulletin John Rylands Library*, 58, 2, 1976, pp. 378-420 at 395.
[23] 26 Hen. VIII. c. 1.
[24] Lily, W. *Institutio Compediaria Totius Grammaticae*, London: T. Berthelet, 1540.
[25] Vesalius noted in excess of two hundred failures by Galen to provide true descriptions of anatomical function. Farrington, B. The Preface of Andreas Vesalius to *De Fabrica Corporis Humani 1543*, *Proceedings of the Royal Society of Medicine*, 25, 9, 1932, pp. 1357-66 at 1363.
[26] Vesalius, A. *De Humani Corporis Fabrica*, Basel: Joannes Oporinus, 1543.
[27] Porter, R. *The Greatest Benefit to Mankind*, London: Harper Collins, 1997, p. 180.

a trigger for evidence-based science and technology and in its composition, it was a milestone of early printing. Although written in Latin, it was translated and piqued a new English interest in structural representation and technical description. Indeed perhaps the earliest English metal engraving was an effort sponsored by Henry VIII, who it is reported, supported a housemate of Vesalius in his assistance to a copper-based plagiarism of forty of the woodcut images from the *Fabrica* for a popular London surgical compendium in 1545.[28]

To this extent sometimes text had no meaning in the absence of accompanying diagrams; yet when complex technical disciplines needed additional exemplification a sufficiency of synthesis in the intellect of the readership was only realisable through precise cognitive supports. This was a key point in the history of technical communication and a pan-disciplinary legacy was realised across previously narrowed precincts. The delivery of this reality to the illiberal pursuits (see also 3.2.1.8 & 3.3.1) fittingly owes much to the promptings and systematic treatment of an author's subject matter by physician-turned-mineralogist Georgius Bauer (1494-1555, 'Agricola'). His *De Re Metallica* (see Table 2.1) contained extensive engravings. The preface contained the justification that nothing is made without tools and this:

> '*…with regard to the veins, …machines, and furnaces, I have not only described them, but have also hired illustrators to delineate their forms, lest descriptions which are conveyed by words should either not be understood by men of our own times,… in the same way…difficulty is often caused by many names which the Ancients have handed down to us without any explanation*.'[29]

Given these obstacles, there can have been no expectation in the adequacy or completeness of a description of a new manufacture during this time, or in its efficacy to indelibly transfer the rhymes of a mechanical art. The provision of such knowledge was far from a trivial issue.

[28] Gemini, T. *Compendiosa Totius Anatomie Delineatio*, 1545-1559.
[29] Translated from the first edn. by Hoover, H. C. *The Mining Magazine*, London: 1912.

2.2.3.2 Easing the transition from scribal non-conformity

The earlier fluidity whereby words might be imported into the English vocabulary (or indeed be replaced later) needed a binding agent. Although the printed word would only achieve adherence to a required orthographic uniformity from 1650 (see Table 2.1) the process was well underway by the mid-1540s and adequately cemented by the 1590s. Not yet so well corralled were aspects of grammar or pronunciation. In one comment that should not surprise the patent historian it has been claimed that 'linguistic prescriptivism became part of the standardisation process only in the long eighteenth century.'[30]

Nevertheless, within England there contemporaneously evolved an explosion of interest in the writing of texts for instruction; once more to the fore were the surgeons. It is contended that, in addition to the acceptance of increased convention, this was a result of the synergistic unity of nascent scientific awareness and enhanced diffusivity of technical know-how, all brought into coalition through liberation of page design. The local catalyst for this genre was Continental-trained Thomas Gale (1507-87) who produced a quadrumvirate of texts: *Certaine Workes of Chirurgerie* including; *An Excellent Treatise of Wounds made with Gonneshot* (1563) the first English work on this theme,[31] eighteen years after French barber-surgeon Ambroise Paré's (1510-90) treatment of the same subject.[32] While linking with earlier modes of instruction through its part-catechistic presentation, the distinguishing feature that catapulted access was the attempt to bypass a denseness of style with the incorporation of tables. Accessing what something *was not* was now becoming as important as what it claimed to describe, particularly for surgery. These part-orthogonal approaches facilitated the circumvention of redundant prose in that they speeded insight, a necessary criterion as texts became ever larger in length. In a craft-based science following on from a required accuracy in diagnosis with extensive re-visits and the prescription of herbals, surgery was ideally placed

[30] Nevalainen, T. Early Modern English (1485-1660) in Momma, H. Matto, M. (eds.) *Companion to the History of the English Language*, op. cit., p. 215. The challenges are treated in Section 6.2.1.5.
[31] Gale, T. *Certaine Workes of Chirurgerie*, London: Rouland Hall Printers, 1563.
[32] Paré, A. *Ten Books of Surgery*, trans. Linker, R. W. Womack, N. Athens: University of Georgia Press, 1969. Despite being ostracised by the medical fraternity, Paré crafted wooden prosthetics with movable joints; even incorporating clock springs and gears to allow grip. Despite his craft origins and failure to learn Latin, Paré's '*intrepide han*d' and '*mind mercilesse*' when coupled with his propensity to record his restorative methods, were an irresistible force for breaking the restraints on the sole practitioner.

to carve a unique technological niche for itself. Small wonder it attracted practitioners keen on self-promotion; an affair facilitated by the new explosion of printed offerings and an increasingly literate audience.

Such tabular arrangements, inspired by the logician method of educational reformer Peter Ramus (1515-72), were based on 'cold-blooded definitions'[33] and as such were seized upon by writers and incorporated into a wide variety of mathematical and medical manuals from the 1570s. An early adopter was Dee.[34] In pursuit of Ramistic categorisation, his 1570 Table both reconnoitred and ransacked the spectrum of traditional and avant-garde knowledge.[35] Ostensibly encyclopaedic, humanistic and mathematical fields were now ordered, conjoined and described as never before. Additional innovations, in order of appearance during the era, and which invoked a cumulative influence on the assimilation and formation of technical know-how, were: the increasing prevalence of tables of contents, the preparation of indices, the replacement of a spacing marker ¶ with formal paragraphing, and the utilisation of better quality type for books of instruction.[36] These made possible the gradual approximation to universal standards, a key convention for technical description.

Pages were now easier to negotiate, but more importantly the integration of formatting with reading had managed to tame the Babel of traditional discourse. In terms of a future relationship for an adequacy of description for an act of invention, each of these typographic novelties ultimately eroded the auditory and mnemonic curricula that had built up during centuries of guild domination and a sparing, chirographic culture. This was no instantaneous quantum leap, it required repeated use to weave its way into the fabric of thinking about a technical subject's matter; though a profound development certainly, the 'early age of printing still felt it as primarily a listening process, simply set in motion by sight.'[37] For many, reading was a slow procedure. A technical description could however, from now, be seen as opposed to heard.[38] A visual representation would certainly augment textual delivery. Any teaching of a science that required a geometric pursuit of the

[33] Ong, W. J. *Orality and Literacy*, New York: Routledge, 2002, p. 131.
[34] Dee, *Mathematical Groundplat* (Mathematical Preface to Euclid).
[35] Sherman, W. H. *John Dee*, Amherst: University of Massachusetts Press, 1995, p. 21.
[36] Tebeaux, p. 47.
[37] Ong, p. 119.
[38] Tebeaux, p. 47.

pneumatic limits for hydrographical evacuation[39] or for looking inside bodies for the truth of a disease for instance, could not ignore the assistance of illustration. Indeed while anatomical medicine was at the vanguard of the utilisation of printed, non-verbal descriptions, in truth its practitioners were themselves but followers of the engineers;[40] some strands of whom have left behind notebooks (often anonymous) of whole series of identikit drawings, a reality that corroborates an active exchange of information in pictorial form among some technologists.

The process of technical transfer was at last departing from orality and auditory memory as sole sources of information. This newer coalition, rather than the shoehorning attempts of art history or architecture to correlate their sole use of illustrations with the proximity accessible from linear perspective,[41] would carve a profound contribution in the acute opening of the European mind. In essence mathematics, as the key to rendering practical problems (from graphical representation across drawings and engineering) more soluble, was increasingly exploited to enhance certainty.

2.3 The inauguration of new collaborations

2.3.1 A manual for new transfusions

2.3.1.1 The alignments of Dover's geometrician

Meanwhile, precepts of guild secrecy had greatly faded. The collectivist perspective thus unravelled, as the notion advanced during this century that applied technological progressions needed the outlet of publication. An example of such bridge-building from federal to individual progression-with-dissemination has been provided by the English inventor William Bourne. Absorbing Recorde's utilitarian advances, this pioneer in mensuration specialised in the arena of instrumentation for navigation[42] and gunnery.[43] He prefaced manuscripts of his most pertinent

[39] Hauling engines and ventilators came into use in the sixteenth century.
[40] Scaglia, G. Drawings of machines for architecture from the early Quattrocento in Italy, *Journal of the Society of Architectural Historians*, 25, 1966, pp. 90-114.
[41] Gille, B. *The Renaissance Engineers*, Cambridge, Mass.: MIT Press, 1966, p. 123.
[42] Bourne, W. *A Regiment for the Sea*, London: 1574.

works with a dedication and apology to Lord Burghley for his dearth of learning: 'verrie sympll & rudly laubelled'.[44] Innovations assisting colonialism were increasingly in vogue. Bourne's 1574 publication was the first native English manual for navigation and the first printed offering of the common log.[45] Although crude, instrumental-based nautical speeds could now be relied upon with guesswork displaced.

Bourne therefore pronounced on matters geometrical, producing cogent descriptions of 'rare' inventions, sometimes incorporating arrays of tables in the format of a bench-side practical manual.[46] Significantly, this early technician-of-record also noted the deficiencies associated with prototypes, stating:

> '*in any arte or science…they that came after them brought it into perfection.*'

So at the forefront of applied mathematical ingenuity, persistence and precision of perspective was demanded: such an internalised attribute of pursuit of exactness must be a prerequisite for literary accuracy in a subsequent efficient drafting of any written description of a technological advance. Yet, there was no expectation hitherto that a written description for an invention was an essential criterion for future profit. For instance, in another of Bourne's books he indicates that the target audience for his writings was 'to give instructions unto them that be of the simple sorte'; so his tome was not necessarily intended for the expert.

So Ancient authorities were accessible to the university educated but thereafter, whenever an alternative approach was required, the drafters of technical-based instruction understood the value of cogency in writing. Much remained to be done however before a specification attached to a patent of invention would have the required currency. At this juncture, it is hard to ignore the telling statistical stasis that in a country where ninety percent of commerce was wool derived; by the reign of James I only in the founding of iron-cannon was England at the pinnacle of product excellence.[47] Mining and manufacturing were expanding greatly. In a

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[43] Bourne, W. *Inventions or Devices*, London: Thomas Woodcock, 1578. Bourne gives credit to the Venetians for this innovation however, pp. 17-19.
[44] This quote from pp. i-ii of a 1576 handwritten manuscript available at http://sceti.library.upenn.edu/sceti/ljs/PageLevel/index.cfm?ManID=ljs345&Page=7 Accessed: 24 October 2016.
[45] Cotter, C. H. The Instruments of Navigation, *Journal of Navigation*, 1981, 34, 2, pp. 280-92 at 286-87.
[46] See example pp. 66-70 (printed book).
[47] Hume, D. *The History of Great Britain*, Vol. 1, Edinburgh: 1754, Pelican reprint (1970) p. 239.

reversal of the flow of technology from the importation of earlier glaziers' into England, the output of John Browne (later gun-maker to the Parliament in the Civil War) required the employment of 200 men at his Kent foundry in 1619 and there was alarm in the Commons lest guns exported to allies be diverted to England's enemies, such as the Dutch, who were in receipt of half.[48] This is a remarkable elevation from the note that there was no record of any cannon having being cast in England before the sixteenth century.[49]

Certainly for gunnery, advances had to be predicated on applying empirical observation of trajectory to a new relationship with quantitative expression and the utility of recording results.[50] For example, a rule had long existed that nine pounds of stone required one pound of powder for projection, yet muzzle bursts remained a hazard owing to barrel imperfections. An account of the moulding and casting of the great guns used against Constantinople in 1453 had much description, but little by way of numerical variables, relying in the main, on units of 'palms'.[51] Like many previous, the fifteenth century had witnessed the currency of warfare; yet the cheque of conveyance through technical drafts in hard-copy format for the implements of its prosecution still remained to be cashed. In the words of Recorde:

> '*for knowledge and certaintie…that mannes witte can reche vnto, there is noe possibilitie without number.*'[52]

Such interest persisted, logic now being pursued into foundry practice; one theoretician observing '…a peece which breakes doth most commonlie breake at the breech or neere unto the mouth and seldom tymes in the middle…'[53]

Bourne, although a seminal figure, was but one of an inspiring cadre. Unencumbered by the ancient imprisonment of their discipline in Greek or Latin, these astute exploiters of a procreative era for English applied mathematics, mostly centred on Gresham College, London's centre for the applied arts (see Chapter 3) in essence formed a new scientific guild but now, through the medium of print, were inspired and lined up to bring their outputs to maximum circulation.

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[48] State Papers Domestic: James 1, vol. cv, no. 92.
[49] By 1640 King Charles' ships carried almost 1,200 heavy guns.
[50] The standard 'yard' was established by Henry VII in 1497.
[51] Cited as Kritobulos in: Clephan, R. C. The Ordnance of the Fourteenth and Fifteenth Centuries, *Archaeological* Journal, 68, 1911, pp. 49-138 at 107-08.
[52] Recorde, R. *The Whetstone of Witte*, London: 1557, preface.
[53] Tartaglia, N. *Three Bookes of Colloquies concerning the Arte of Shooting in Great and Small Pieces of Artillerie*, trans. Lucar, C. London: 1588, colloquie 22, p. 41.

2.3.1.2 A transfer to the vulgar arts

One impediment to an efficiency in diffusion of technical knowledge was that the period's juvenile approach to a logical arrangement in the typesetting of tabular representations meant that manuscript versions of these systematic displays, being more efficient in requiring less repetition, were often more accessible to the reader than the printed offering.[54] This placed a premium on the writing skills of the author and the interpretative faculty of the reader.

Any deficiency in the handling of technical text and analogue recording has also been reinforced by one commentator who contends that a legible, logical page design did not emerge until the seventeenth century.[55] In terms of ballistics, the challenge of relaying dimensions certainly so persisted even to specialists.[56]

Perhaps the most impressive attempts to apply the arrangement of arrays were advanced by Scot John Napier (1550-1617). In a coalition of numeracy, diagrams, literacy and indeed models he invented advanced aids for the mechanisation of calculation.[57] An early publisher of logarithms[58] his advances were introduced (with manuscript) in tabular decimal form by Henry Briggs (1561-1631)[59] and published as tables of logarithmic trigonometrical functions by Edmund Gunter (1581-1626) by 1620.[60] Gunter's first version was in Latin, soon followed by a vernacular offering. Either side of these advances Gunter devised another momentous advance, the sector. Starting as a gunnery aid, the horizons of his 1606 'military compass' was followed by success in bringing something approaching perfection in instrumentation in what was to be the most important work on Cecil's favoured science of navigation.[61] While the published descriptions[62] (coincidentally from the same year as the Statute of Monopolies) of Gunter's logarithmic scales ultimately led to the later development of the slide rule,

[54] Walton, S. A. *The Art of Gunnery in Renaissance England*, University of Toronto PhD thesis, 1999, p. 90.
[55] Tebeaux, pp. 36, 216.
[56] Sturmy, S. The Mariner's Magazine: or, Sturmy's Mathematical and Practical Arts London: E. Cotes, 1669, p. 49.
[57] Napier, J. *Promptuary for Multiplication* in: *Rabdologiae*, Edinburgh: Andrew Hart, 1617, pp. 91-112.
[58] Napier, J. *Mirifici Logarithmorum*, Edinburgh: A. Hart, 1614.
[59] Briggs, H. *Logarithmorum Chilias Prima*, London: 1617.
[60] Gunter, E. *Canon Triangulorum*, London: W. Jones, 1620.
[61] Gunter, E. *The Description and use of the Sector, Crosse-Staffe and other Instruments*, London: 1623.
[62] Wingate, E. *L'usage de la Reigle de proportion en l'Arithmetique et Geometrique*, Paris: 1624.

more saliently here, the accompanying copperplate engraving was insufficiently large to enable access to consistently accurate readings.[63] In its subsequent forcing of practitioners to rely on printed tables of reference it may have indirectly resolved the issue of the status of the 'model' in favour of the eventual primacy of the written description just as scientific advances were on the cusp of a new systematic paradigm. Further highlighting the limitations of prototypical models in information transfer, the complexity of Napier's device denied its diffusion. Showing the impact of the new information channels however, his more standard two-dimensional Latin output, relayed on conventional print, turned up in China and Japan within a short time of publication.[64]

This surely was a culmination of the promptings initiated by the geometrician and paramedical fraternities; and the struggles of the early surgical scribes through to their successors at the propagation of printing in revealing a reward that was transferrable to other technical disciplines. Their application of reason and unearthing of new techniques, had soldered the imperative of these early technologists in writing down what they had learned as image-supported text, but now required accuracy and a precise formatting to present frontier technological thought and practice. Increasing knowledge and the wish to self-promote (initially) and teach (later) therefrom, still yet denied the entirety of a written description alone; a clear, unambiguous delivery demanded an additional substrate of receptive accommodation to secure this knowledge in the mind of the reader.

2.3.2 The legacy of faith

2.3.2.1 Casting off the shackles of orthodoxy

Although Briggs and Gunter were clergymen, there remained a suspicion also on those who studied matters temporal rather than spiritual, so there was always that cloud which might gather over any who deviated from accepted pathways; and the

[63] Cotter, C. H. Edmund Gunter, *Journal of Navigation*, 1981, 34, 3, pp. 363-67 at 365.
[64] Napier, John, *Rabdology*, trans. Richardson, W. F. Charles Babbage Institute, Reprint Series for the History of Computing, Vol. 15, Cambridge, Mass.: MIT Press, 1990.

facile true faith was to deny change, not least in the craft mysteries long associated with oral transfer of technical information.

Like Bradmore, Bourne, although apparently not a guild member, was the epitome of the independent, lay inventor essential to bridge this gap. For demystifying the standing of transfer of information, it is noteworthy that the latter, in describing his invention for *its* secret conveyance, proposed:

> '*if you have any great quantitie of letters or books…and would not neither lose them, nor have them found, nor knowne…then doo this:* '[65]

These literary developments from the technological domains of medicine and geometry-informed ordnance, being from either side of the second English patent grant (Smyth's, discussed later) and the sheer breadth of time spanned,[66] suggest but a gradual liberation of tidings if not knowledge, which, coupled with the influence of such passages, signify that a major gap to modernity needed to be broached; they also provide a hint for themselves of a newly activating power.

2.3.2.2 The advent of editorial scrupulousness

Steinberg has opined that: '[I]n England, as everywhere else, the printing press has preserved and codified, sometimes even created the vernacular.' [67] Such an upheaval on thought could today be said to be a twice a millennium event but nobody then had the benefit of modern-day foresight. A further dissection continued:

> '[*T*]*he preservation of a given literary language often depended on whether or not a few vernacular primers, catechisms or Bibles happened to get printed (under foreign as well as domestic auspices) in the sixteenth century. When this was the case, the subsequent expansion of a separate "national" literary culture ensued. When this did not happen, a*

[65] Bourne (1578) p. 60.
[66] From 1449 (John of Utynam, glazier & glass inventor responsible for early windows at King's College, Cambridge) to 1552 (Smyth).
[67] Steinberg, S. H. *Five Hundred Years of Printing*, Bristol: Penguin, 1961, p. 120.

prerequisite for budding "national" consciousness disappeared; a spoken provincial dialect was left instead.[68]

In support of the key element of providing succour to a 'national literary culture' it can be contended that the enduring legacy of Thomas Cromwell, and one not irreversibly interrupted by the accession of the stoutly Catholic Queen Mary to the throne in 1553, was the provision of a substantial (for church purposes) version of the first authorised English Bible. Printing initially took place in Paris where the better quality presses were located, but after political and inquisitorial hesitation by the French king, the printers' plates and some printed stock were retrieved and imported; the intention being to supply each of the 8,000 parishes with their own copy of this early reforming 'Great Bible'. Produced in 1539, the king (Henry VIII), clearly keen to keep Rome at arm's length, was portrayed on the title page distributing Bibles to both clergy and laity. As Campbell states: '[T]he Reformation had been accompanied by a revolution, one in which a book that had been imprisoned in Latin had become accessible in the everyday language of the English people.*'* [69]

Especially relevant here was the impetus to the growth in literacy stimulated by the perceived desirability among the Protestant faithful of the value of being able to read scripture.[70] Yet another paving stone on the path to a functioning maturity in technology transfer was being laid down. Nonetheless literacy was not yet fully unleashed. The 'authorised version'[71] would not appear until later: while for now, smaller editions in more legible Roman type for private use only appeared post 1617.[72] So the integration of what was perhaps the most important translation in English history was still not fully in phase with its latent impact.[73]

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[68] Eisenstein, E. L. Some Conjectures about the Impact of Printing on Western Society and Thought: A Preliminary Report, *The Journal of Modern History*, 40, 1, 1968, pp. 1-56 at 19.
[69] Campbell, G. *Bible*, Oxford: University Press, 2010, p. 23.
[70] Shaw, D. J. The Book Trade Comes of Age: The Sixteenth Century, in: Eliot, S. Rose, J. (eds.) *A Companion to the History of the Book*, op. cit., p. 210.
[71] The 'King James' Bible had profound impact.
[72] Jeffery, D. L. *The Bible* in: France, P. (ed.) *The Oxford Guide to Literature in English Translation*, Oxford: University Press, 2000, pp. 159-72, at 171.
[73] *Ibid*. John Bunyan, author of the *Pilgrim's Progress* departed from its format in order to align with 'common speech'.

2.3.2.3 The laity thus elevated

The medium of everyday communication was nevertheless becoming ever more wedded to the printed word in a virtuous circle from cradle to grave. The role of the guilds in stymieing a writing down of technical instructions was becoming redundant and the part of a more standardised vernacular in removing this enfeeblement was dawning, but this was not the sole origin of the role of language in formalising the transfer of scientific knowledge. The effect was altogether more cumulative. So where reliance on oral discourse had been the prevailing mode of everyday communication, the enhanced accessibility of the printed word now made it possible for the pattern of one's mother tongue to achieve a new fixity and consistency.[74] This effect can only have achieved its greatest impact during the curiosity associated with childhood but would have persisted to those entering a trade as an apprentice. More importantly, it ultimately influenced the enveloping of the entire intra-technical arena of any trade within a newly consistent and homogeneous approach to descriptions of process. The later leap to the formality of the written description for a patent was therefore unavoidable.

2.4 Fail to prepare, prepare to come up short

2.4.1 Literacy and technique become integrated

Nevertheless, some foot-dragging was apparent. Strikingly, this recalcitrance occurred within the arena of the glass patents. The clue is that during the late sixteenth century the Privy Council became enmeshed in aspects of this important industry. For the industrial policy of Elizabeth was by now tasked with the objective of reviving or introducing mining and metallurgical industries and was 'destined to exert an important influence on the development of the glass industry.'[75] Venetian, Giacopo Verselini, was granted a twenty-one year patent covering manufacture and sales of drinking glasses that was itself coupled to a

[74] Eisenstein, p. 20.
[75] Hulme, E. W. *The Antiquary,* Nov. 1894, p. 210.

prohibition on imports.[76] Numerous infringements were reported.[77] Although this grant endured for an inflammatory period up to 1642 being a *de facto* monopoly for nigh on seventy years and is thus worthy of analysis in its own right, its pertinence lies not in its longevity, but in something more subtle and described next.

2.4.1.1 The arboreal well is almost dry

A national concern of securing adequate supplies of lumber persisted. This was a consequence of the destruction of the forests, with glassworks being a major contributor.[78] Verselini's patent had been contemporaneous with the arrival of Huguenots from Lorraine and Normandy and some who were glassmakers, worked outside the terms of the patent. These craftsmen were to find it necessary to implement a nomadic pursuit of fuel, with some arriving ultimately in Worcestershire. After access to fuel once again became problematic, experiments were conducted using the local deposits of surface coal. Price reports that the resultant glass was less than perfect but word spread back to the original glass-making locations of Surrey and Sussex and eventually, an exclusive patent for a non-wood consuming process for glassmaking was granted to one Sir Edward Zouch and partners.[79] This arrangement was soon subsumed, through a new patent,[80] under the powerful status of the Earl of Montgomery and Sir Robert Mansell; the latter ultimately acquired the entire interest.

After several of the French denizen strangers had had warrants issued for their arrest for violation of this grant,[81] the Privy Council ordained that for the relief of the latter it was ordered that the patentees should buy up *their* materials and equipment at reasonable prices:

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[76] A patent whereby: *all might purchase freely from him*; Pat. 17 Eliz. I. pt. 13 (15 December 1574) is recorded in Price, W. H. *The English Patents of Monopoly*, Boston: Houghton Mifflin, 1906, p. 69. Page meanwhile has reported: 'VERSELYNE, James from the dominion of the Doge of Venice. 26 November 1576; Pat. 19 Eliz. I. p. 3 m. 38. Licence to James Verselyne to make drinking glasses in England and Ireland for 21 years. Cal. SPD Eliz. I. 1589-94, p. 179. James Verselyne, a fugitive…carried on the craft…in Crutchet-friars, London.' See Page, W. *Letters of Denization and Acts of Naturalization for Aliens in England, 1509-1603*, Huguenot Society Publications, Vol. viii, Lymington: 1893, p. 246.

[77] Price, pp. 69-70.

[78] Darby, H. C. *A New Historical Geography of England after 1600*, Cambridge: University Press, 1978, p. 28, recounts the felling of 30,000 trees in the Forest of Dean from 1600-67 to feed the iron furnaces. Also: Landsdowne Manuscripts, 59, No. 75.

[79] Pat. 11 Jac. 1, pt. 16 (4 Mar. 1614). See Price, pp. 71-72.

[80] Pat. 12 Jac. 1, pt. 3 (19 January 1615).

[81] *Ibid.*, Council Registers 30 November 1614.

'provided the Sussex glass makers would give up their skilled workmen for the benefit of the patentees. '[82]

This requirement confirms that despite the promptings emanating from increasingly prevalent descriptions of technologies, even for the policy-making elite of England there remained such a legislative vacuum that there was still, particularly for immigrant expertise, no mechanism to efficiently convey technological proficiency other than through innate human skill and knowledge. That this occurred as a stipulation of a patent in the early seventeenth century just a few short years prior to the 1624 Statute of Monopolies,[83] is evidence of the still latent need to give effect to a new, formalised method to transfer necessary expertise.

2.4.1.2 The sacrilege of the glassmaker's notebook

A profound stimulus was not far away having been published in Italy just two years previously. One particularly relevant medium for the execution of the inevitable change was provided by an alchemist and glassmaker in the employ of the Medici family. Antonio Neri was the author of the first book devoted to the craft of the glassmaker as formulator.[84] As Engle has noted:

'[*H*]*is book provides a rare glimpse of skilled practical knowledge. This was an era when prized techniques were frequently lost to subsequent generations; lost because artisans so often spared the pen.*'[85]

In such an environment, aside from the obvious inefficiency to society of the failure to record for the benefit of following craftspeople, an inventor could easily be associated with magism, an accusation unlikely to stimulate one to keep records for posterity or anybody else. It needed a brave person to dip their toe in such unforgiving waters. Fortunately, some existed, particularly as printing accelerated the study of thought and literature but such individuals tended to be exceptional. In his text, Neri shows his familiarity with materials, describing how the starting substances might be refined to the required purity and then, combined

[82] *Ibid.*, Council Registers 21 December 1614.
[83] Section XIII of the Statute, being a proviso for a grant of glass making, absolved (in name) Mansell's earlier 'condemnation'.
[84] Neri, A. *L'Arte Vetraria distinta in libri sette del R. P. Antonio Neri Fiorentino. Ne quali si scoprono, effetti maravigliosi, et insegnano segreti bellissimi, del vetro nel fuoco et altre cose curiose*, Firenze: Nella Stamperia de' Giunti, 1612.
[85] Engle, P. *A Deeper Accomplishment, Conciatore: The Life and Times of 17th Century Glassmaker Antonio Neri.* See http://www.conciatore.org Accessed: 24 October 2016.

through a series of processes to glasses of various colours. A listing of the actions involved across seven steps (as recorded by the Corning Museum of Glass) is instructive as to the breadth and complexity of what Neri recorded. In a sample sequence one finds:

> '*preparing the fundamental ingredients; combining those materials; showing the standard formulas; proceeding to improve upon them; the way to decolorize (even a slight …hue); preparing recipes for exquisite chalcedony; describing leaded glasses…and glass paints*.'

This was ultimately to become the standard text for this industry and was translated into multiple languages.[86] The ubiquity of the outputs from these processes negated the barriers of language, both spoken and intra-technique.

One of the prime repositories of this inventive magic was among the alchemists and in particular their act of transmutation of metals; this being a particular forte of Neri. From ancient times successful chemistry had been restricted by knowledge of how to isolate pure material. Its nomenclature of separation was handed down as traditional knowledge. Such erudition was known in Latin as *receptio* or received wisdom.[87] It was a sacrilege to write such knowledge.[88] It could only be received through inheritance and thus, uninitiated multitudes could not cause profanity of such divine mysteries.[89] How then to divorce such ancient shackles from the later need to convey knowledge based on experience? Neri's contribution was to unify an amalgam of individual mysteries under the umbrella of chemical science and deliver this to the written word.[90]

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[86] Engle, P. *Antonio Neri: Alchemist, Glassmaker, Priest.*
See http://www.cmog.org/article/antonio-neri-alchemist-glassmaker-priest Accessed: 24 October 2016.
[87] Grazzini, M. G. Discorso sopra la Chimica: The Paracelsian Philosophy of Antonio Neri, *Nuncius*, 2012, 27, pp. 411-67 at 437.
[88] Rulando, M. *Lexicon Alchemiæ sive Dictionarium Alchemisticum*, Frankfurt: Zachariæ Palthenii, 1612, p. 108 noting '*Vox est Hebræa, Latine dicitur Receptio: quod una cum lege;…quam scribere nefas erat:…*'
[89] Grazzini, p. 437.
[90] See 3.4.2 for a later impact of durable glass vessels in Britain.

2.4.1.3 The expression of thought: a bright shining truth

For the aeons evaluated thus far some of the key players and pertinent outputs of this philosophical metamorphosis were contributors as geographically and sociologically diverse as the following synopsis (concluding with the 1755 publication of the standard dictionary of the English dictionary[91]) suggests. This lexicon of language emerged after Nasmith's emergent patent specification,[92] but before the Lord Mansfield defined requirement for same in *Liardet v Johnson.*[93]

[91] Carter, J. Muir, P. H. (eds.) *Printing and the Mind of Man*, London: Cassell & Co. 1967, pp. 6-7, 13-14, 25, 28, 47-8, 54, 66, 74-76, 80-81, 97-98, 121.

[92] GB 387 [1711]. While the 'origin of specification' was initially nominated by Webster from 11 Anne, Hulme (1897, p. 316) elaborates from the prior unpublished grant (Patent Roll, 10 Anne, Part 2) that Nasmith proposed to supply what the invention consisted of 'in writing under his hand…after the passing of these our Letters Patents...' See: Webster, T. *The Law and Practice of Letters Patent for Inventions*, London: Crofts & Blenkarn, 1841, pp. 5-6.
Hulme's analysis remains central to the history of the specification. Hulme, E. W. The History of the Patent System under the Prerogative and at Common Law, *The Law Quarterly Review*, 12, 1896, pp. 141-54. This 'essay' was published in four parts in *LQR*, also: 'On the Consideration of the patent Grant, Past and Present', 13, 1897, pp. 313-18; 'The History of the Patent System under the Prerogative and at Common Law – A Sequel', 16, 1900, pp. 44-56; and 'On the History of the Patent Law in the Seventeenth and Eighteenth Centuries', 18, 1902, pp. 280-88.

[93] 1778 Bull NP 76; 1 Web Pat Cas 53. See Chapter 3.

Table 2.1 Printing & method: the gradual formalisation of language & technique

Author	Period	Title	Publication	Features & Impact
Isidore of Seville	d. 636	*Etymologiae (Origins of Words)*	G.Zainer, Augsburg: 1472	The chief authority of the Middle Ages; a text found in religious houses and colleges.
Robertus Valturius	1413-84	*De Re Militari*	J. Nicolai, Verona: 1472	The earliest illustrations of a technical or scientific character; featured 82 woodcuts.
Thomas Littleton	1407-81	*Tenores Novelli (Treatise on Tenures)*	J. Lettou & W. de Machlinia, London: 1481	Anglo-French not Latin. Dealing with English law, featured new systematic classification and illustration of property rights.
Hieronymus Brunschwig	1430-1512/3	*Das Buch der Wahren Kunst zu Distillieren (True Art of Distilling)*	J. Grüninger, Strasbourg: 1512	Described the techniques (using wood-cuts of chemical apparatus) whereby active principles might be obtained in pure form and used in treatments.
Thomas More	1478-1535	*Utopia*	T. Martens, Louvain: 1516	Inveighed the utility of the homogeneity of his vernacular: '*not deficient in terminology…and adapts itself as well as any to the expression of thought.'* [94]
Georgius Agricola	1494-1555	*De Re Metallica (On metals)*	J. Froben & N. Episcopius, Basle: 1556	Physician who drafted scientific classifications. First modern technological book with elaborate techniques on mining engineering. 273 large wood-cut illustrations.
Henry de Bracton	d. 1268	*De Legibus et Consuetudinibus Angliae (On the Laws and Customs of England)*	R. Tottel, London: 1569	Integrated legal maxims with their practical application in common-law courts; his formulated principles defined precedent.
Paracelsus	1493/4-1541	*Opera Medico-chemico-chirurica*	Collegio Musarum Palthenianarum Frankfurt: 1603-5	Instigated the first approach to method and the use of drugs by abandoning the established system of 'humours'.
Edward Herbert	1583-1648	*De Veritate (On Truth)*	Unidentified, Paris: 1624	English precursor to Descartes; his theory of knowledge defined truth as the collective equation of one's faculties of apprehension (*via* the senses) with objects and reason.
Edward Coke	1552-1634	*The First Part of the Institutes of the Lawes of England*	The Society of Stationers, London: 1628	Including accounts of how he championed the status of the common law in defiance of the king's prerogative.
John Lilburne	1614-57	*An Agreement of the Free People of England*	G. Calvert, London: 1649	Asserted the right of every freeman to justice under the law, including freedom of conscience and speech ('*that the Presse might be open for us as you*'). Instigated the Leveller movement and attacked the intolerance of Presbyterianism.
John Locke	1632-1704	*Two Treatises of Government*	Awnsham Churchill, London: 1690	The most timely refutation of monarchical absolutism; advocated democracy in that civil rulers hold their power but conditionally.
Samuel Johnson	1709-84	*A Dictionary of the English Language* Proposed by the Royal Society: 1664	Printed: W. Strahan, London: 1755	*The* lexicographic foundation-stone through its standardisation of spellings and definitions, coupled with extensive and apt illustrations.

[94] More, T. *Utopia*, Logan, G. M. Adams, R. M. (eds.) London: Folio Society, 2011, Book II, p. 59.

This sample contours the interfaces between individual freedoms under the law, printing, and how a newly liberated medium of instruction was emerging for scientific endeavour. Who were the consumers of these materials? The entries were selected mainly for their effect and durability; but in general terms, while three-quarters of books published in the fifteenth century were in Latin, by the end of the following century, greater than fifty percent were available in the vernacular languages.[95] Although populations were growing and urban centres expanding, these were proportions and this confirms that there was, in addition to the heretofore educated, professional person-as-reader, an additional cohort of newly literate members of society.

More saliently here, the deficiencies of an exclusively oral tradition were also open for dissection. Agricola was one of the very few authors before 1600 who understood the mechanical arts. Yet he curiously published, without criticism, several erroneous assertions regarding metallurgy. The diffusion of these induced the recoil of an early riposte in technical peer review. Several of his invalid appraisals, presumably inherited from antiquity, were rejected by scholar William Gilbert.[96] Print was from now the usher of technological fidelity. Conversely there can be no expectation that a petitioner will faithfully discharge their duty to provide a description in writing or drawing of their invention in the absence of a requirement that the validity of a grant depends on the sufficiency of their specification. This would emerge but gradually (following). Yet the format of rejection for specious claims in technology had now been instigated. That this emanated (like Bourne) from another with a devotion to his nautical instruments and thus especially dependent on accuracy, is particularly appropriate.[97]

Table 2.1 also traverses the incunabula and this was when the threshold of supply met and helped drive a new continuum of demand. Prior to this metamorphosis a diligent copyist was capable of producing about two books per year. The print run of an average book ranged from two hundred to one thousand copies once printing commenced.[98] Coupled with increased availability of texts, a

[95] Hirsch, R. *Printing, Selling and Reading, 1450-1550,* Wiesbaden: Harrassowitz, 1967, p. 132.
[96] The father of the coupling of observation with experiment (see also Chapter 3).
[97] Zilsel, E. The Origins of Gilbert's Scientific Method, *Journal of the History of Ideas*, 1941, 2, 1, pp. 1-32 at 2-3.
[98] Eisenstein, p. 3.

lowering of the bar for attaining additional comprehension occurred; reading was becoming integrated as the transfusion of understanding to the individual. A hand-over of technical knowledge *via* a patent specification would later be entirely compatible with this attribute.

2.5 Patents for invention re-emerge but still don't show their wares

Phillips has deconstructed Seaborne Davies' arguments that Elizabeth's Secretary of State, William Cecil, must have been implicated in the preparation of such an important element of policy as the granting of patents for invention.[99] He has also differentiated between and eliminates the significance (in this context) of two other endeavours then in receipt of letters patent; those for trade routes and those for copyright privileges.[100] However the import of some of the adjacent grants of this era represents an essential area of study for the emergence of the written description.

2.5.1 Smyth's grant: a vital catalyst for policy development.

After an early, outlying grant in 1449 to the glazier John of Utynam a stupendous interval of a hundred and three years expired before there was issued this licence.

26 April. 'Whereas Henry Smyth of London, merchant, intends to bring certain strangers into the realm expert in making…"Normandy glasse," whereby divers of the king's subjects "may be sett to worke and get their lyvying and in tyme learne and be hable to make the said glasse them selfes" and instruct others: …[101] II. 946. Westm., 20 April.

The patentee intended to introduce foreign workmen '*mete and experte'* in making:

[99] Phillips, J. The English Patent as a Reward for Invention: The Importation of an Idea, *Journal of Legal History*, 3, 1, 1982, pp.71-79 at 73-74.
[100] *Ibid.*
[101] C/66: Calendar of Patent Rolls, TNA, 6 Edw. VI, pt. 5, m. 6. C66-846– Calendar, 6 Edw. VI, Part V 1552, p. 323.

'*...which shall not only be a great comoditie... but also bothe in the price of the glasse aforesaid and otherwise a benefite to our subjectes ...and so from tyme to tyme thene to instructe the others in that science and feate…No...persons not licensed...shall attempte or presume to make...said brode glasse or any other fytte for wyndowes upon peyne of forfayture.*'

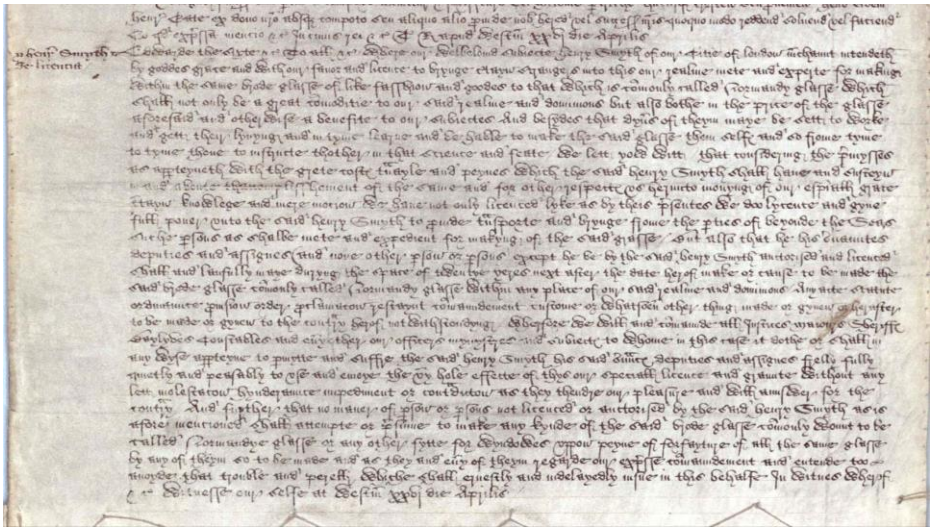

Figure 2.1

Licence for Henry Smyth, 20 April 1552

(Photographed from original roll C66-846 held at TNA)

While this grant has been frequently referred to[102] as just one in a series of sporadic issues, it is important. It maintained a link with the earlier grants. It required a form of transfer of knowledge for the later benefit of the kingdom and those domiciled within. It would lead to an expansion of the indigenous skill base. It was for inventive activity. It was the trigger for the tide of following pre-Commonwealth grants. It would remove potential scarcity of glass, satisfying an unmet need. Also stated, Smyth's patent contained the aspiration that the price of goods would ultimately fall (the grant was for twenty years).

[102] Seaborne Davies, D. Further Light on the Case of Monopolies, *Law Quarterly Review*, 48, 1932, pp. 394-414 at 396.

This represented the earliest recorded confirmation of the latent power of such a grant, the importance of equipoise around such dispensations and an interesting contrast to the fears of opponents of the patent system who contend that grants can deny and/or delay competitor research and postpone price reductions. Despite this awareness, there was a lack of momentum and no reach-through as to how the queen's subjects were to be instructed to carry on any techniques learned therefrom. Given the aspiration that this merchant was to secure the expertise abroad, it is tempting to speculate on the re-ignition of a long-disregarded 'policy' from the reign of Henry VI. Cecil, appointed Secretary of State in September 1550 (under Edward VI) had instigated his strategy for transforming trade, one mechanism being the provision of enticement or succour to foreign artisans. The period under Mary (1553-58) was less auspicious for Cecil and it was only under Elizabeth that he returned to his prestigious post. Thereafter, the acceleration of state-sponsored encouragement to England's 'new industries' occurred.

Through maintaining a link with the aspirations of Utynam's patent, Smyth's grant defined the parameters of the English perception of a workable policy for progressing invention. Figure 2.1 shows it was recorded not in Latin, but in the English language. Crucially, it also moulded a space within which monopolies of many colours would be controlled by a grateful Crown. Ultimately, what was a sensible policy unravelled at the cross-roads of the royal prerogative and exchequer necessity. Further evidence of the ongoing maturation of the embryonic system represented by this patent, rest in its similarities with that to Speyer in Venice a century earlier.[103] The forfeiture of glass element, resonates with the 'fine' therein which, as an equitable remedy, was a consequence of being detected and losing an action for infringement. Reflecting a further degree of subtlety, the grants, in recognising the importance of the implements by which artisans ply their trades, threatened forfeiture of these vital apparatus. Policy was at last moving into position so as to be able to process technical advance, provide some comfort of protection and also absorb scientific information in a coherent and durable way; however, this had not yet precipitated as a demand for a written assignment of technological instruction for following practitioners.

[103] Prager, F. D. A History of Intellectual Property from 1545 to 1787, *Journal of the Patent and Trademark Office Society*, 26, 11, 1944, pp. 711-60 at 750.

2.5.2 First working demonstration & written descriptions

2.5.2.1 Pay-dirt and the demonstration of utility

The anticipation that a newly enlightened policy was crystallising, is circumscribed somewhat as, two years later Burchart Cranyce/Craniche was granted (Figure 2.2) this dispensation:

> '*Whereas by indenture, 18 May, 1554, the queen has covenanted with Burchart '…during the space of 20 years…to 'myne breke grounde melte devyde and serche' all manner of metals in any place within the realm…;*
>
> *Command to all…owners of the ground… to suffer him and his servants…all things necessary for the furthering of the mines.*
>
> *Inhibition to all other persons within the next six years to melt, separate or divide any of the metals which Burchart shall…provided that this grant be not prejudicial to the inhabitants, workers or miners of the stannary.'*[104]

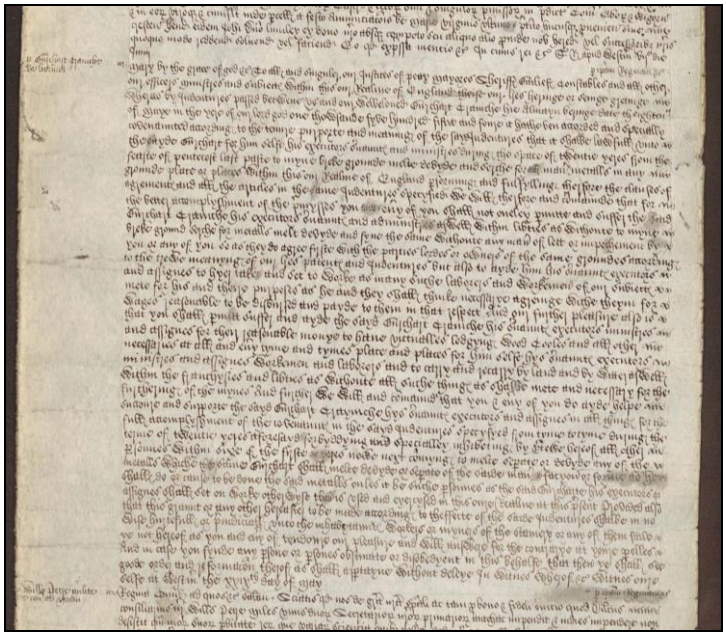

Figure 2.2

Letters Patent awarded to Burchart Craniche, 29 May 1554

(Photographed from original roll C66-869 held at TNA)

[104] C/66: Calendar of Patent Rolls, TNA, 1 Mary, pt. 6, m. 13, C66-869. Calendar, Philip & Mary, Vol. 1, 1553-54, pp. 159-60.

As also included was the phrase 'of the fashion which he shall do' for separating mineral from co-extract, there is therefore no evidence of the grantee leaving a legacy of the transfer of valuable technical knowledge here. He received authority under the monarch's prerogative such that this was but a licence to exploit people and resources and this time *via* authorisation in their own language. Small wonder Elizabeth assumed an already impoverished realm.[105] The significance of the grant is that this failure to adhere to any process of indigenous elevation marks it as *the* nadir of a study on the need for a written description for inventions.

It is important to acknowledge that Craniche has a claim to a vital link in the chain of nascent policy development towards patents for invention in England, with an entry in the Calendar of Patent Rolls for 22 June 1563 recording a twenty year grant for an engine for the draining of waters. This grant is similar to that of Medley's,[106] but gives some additional powers of entering upon old and abandoned mines under proper restrictions. The engine is stated to have been:

> '*lately invented, lerned and found out by Cranick, and to be unlike anything devised or used within the realm. Three years are allowed for the patentee to perfect and demonstrate the utility of his engines...*'[107]

This seems to be the first grant providing for *demonstrable* adequacy of satisfactory technological advance yet this was all in the absence of a formal requirement for an adequate written description. However, early stirrings were apparent as also of significance, were the use of the expressions utility and patentee. The interest in and crucial importance of claimed innovations in drainage equipment and methods can be further gleaned from the aforementioned Medley grant. It provided for disputes to be referred to the Privy Council no less and also, in an additional enticement to the patentee, raised the possibility of compensation for bringing the technology to abandoned mines.

[105] This is not to detract from his capability or perseverance. 'Cranyce' too was a 'Doctor in Physicke'. See Seaborne Davies (1932) p. 396.

[106] A 1562 grant to John Medley for an instrument for the drayninge of water [for 20 years]. *Cf.* Hulme (1896) p. 146.
[107] *Ibid*.

2.5.2.2 The beginning of (an as yet tethered) written description

The year 1561 had introduced additional pieces of the montage for the submission of a written description. Being a follow on to Craniche, a ten year licence to Groyett and Le Leuryer was made on 3 January, subject to: (i) inspection of their soap product by the municipal authorities, and (ii) not fewer than two of their 'servants' being of native birth.[108] A quantum leap followed on 8 August when London mercer Philip Cockeram and haberdasher John Barnes received a privilege of identical duration for making saltpetre (a trade in which they were unlikely to have served as apprentices) upon the queen's withdrawal;[109] this essential military matériel not then being manufactured in England, thus necessitating its politically tricky and nautically hazardous importation. The licence had initially been earmarked for one Gerard Honricke. This 'almayne Captain' was to teach the queen's subjects and to be paid £300:

> '*provided that the secrets of the manufacture should be reduced to writing…*'[110]

The power of written disclosure for regulatory advantage was at last acknowledged. Yet, akin to the aforementioned invention of Bourne, there was a sense that the reduction of a description to writing was tantamount to the preservation of a secret. This was but a tantalisingly short step to the emancipation of knowledge understood to be part of the patent bargain; rather the focus of information revelation was still on the physical hand-over to apprentices and journeymen.

[108] Hulme (1896) p. 145.
[109] Patent roll, 3 Eliz. I. pt. 6.
[110] Hulme (1896) p. 145.

2.5.3 The disputed role of Acontius in the development of the English patent system

2.5.3.1 William Cecil, Lord Burghley: the record keeper for Elizabethan industry (if not invention)

Shortly after the former Craniche grant Cecil had noted an application from… [I]talians seeking a dispensation for silk 'manufacture'.[111] This only informs that he was an omnipresent Secretary of State with commendable attention to detail and establishes his import for later historians; it does not prove he was the principal catalyst for the system yet to emerge. It also suggests that the social and economic integration of England was increasingly recognised abroad.

Events relating to requirements for a written description remained slow-moving however. Verification may be gleaned from the claim that Cecil's success in regulating trade *via* monopoly was carried forward by James I and later, Charles I who saw their role as one of consolidating quality in existing cloth trades (for export) rather than the introduction of new arts.[112] The emphasis, like that to Groyett[113] for the white-soap licence, was on detection of flawed product through the inspection of an alnager rather than through a more enlightened policy of formalised knowledge-transfer and training.[114]

This was a bump of expediency, as it had, since the Kempe permit to the Utynam patent and all the way to the mid-eighteenth century, been understood that the patent grant was contingent upon the working in England of the technological advance. This was to remain[115] a persistent perspective.[116] There was a clear benefit to society in the nature of such proclamations. In a similar vein, the public weal would remain in the consciousness of the common law courts thereafter with individual patents and charters of incorporation being upheld in some seventeenth

[111] SPD Eliz. I. 12, 1558-1603, viii, 32-35, 1559.
[112] Fox, H. G. *Monopolies and Patents: A study of the history and future of the patent monopoly*, University of Toronto Press, 1947, p. 186.
[113] Cunningham, W. *The Growth of English Industry and Commerce in Modern Times, The Mercantile System,* Cambridge: University Press, 1891, p. 78.
[114] The Company of Soapmakers of Westminster was incorporated in 1631. Their inspection privilege fell under: *Patent Rolls*, Indenture 8 Car. I. pt. 5 (3 May 1632).
[115] The later 1902 Act mandated searches to affirm that an invention was new in Britain. Patents Act. 2 Edw. VII c. 34.
[116] That of 1907 provided for compulsory licensing of imports covered by a patent. Patents and Designs Act. 7 Edw. VII c. 29.

century cases on the basis of the common good.[117] However Elizabeth was particularly dependent upon her minister Cecil, who was very much a consensus operator in that he left behind ample annotations outlining the advantages and drawbacks of diverse modes of action without ever specifying a decisive course. He was keen to augment the native repository of skill, an objective now tantalisingly possible as persecution of Protestants became widespread on the Continent. He was not averse to diluting the enforcement of laws that might make England less attractive to those so afflicted; any in possession of attributes that could render his island country more self-sufficient.[118] The absolute military necessity of the Honricke recipe[119] aside, this was an atmosphere antithetical to the inevitable constraints imposed by any requirement for a written description for the subject of a monarch's prerogative. [120]

The complexity of these matters resulted in a subtle change in gear as the last decades of the century dawned.[121] The heretofore supportive atmosphere for inventors entered a partial vacuum. Most famously, the Reverend William Lee's stocking frame (1589) and Sir John Harington's water-closet (1596) were denied the protection of deserved patents for invention. The former was held to be potentially injurious to the interests of hand-knitters; the latter the stand-out invention of the era, had to wait a century and a half for its introduction (although it received a patent in France). Harington's reaction was:

> '*…if Mr. Plat will follow my advice he shall impart his rare devices gratis, as I do this, and we may one day be put in the chronicles as good members of our country*.'[122]

This extract demonstrates the awareness of the power of disclosure but more accurately, Lee's device cleared the way for the merchant clothiers, who, in monopolising ownership of the frames, accelerated their tightening of the noose of

[117] The printing of Bibles and legal texts being examples; also, the charter for the East India Company. Dawson, N. English Trade Mark Law in the Eighteenth Century: *Blanchard* v *Hill* Revisited-Another '*Case of Monopolies*'? *Legal History*, 24, 2, 2003, pp. 111-42 at 127.
[118] Cunningham, p. 84.
Also: Stow, J. *Survey of London*, J. Windet, London: 1603, *op. cit.*, reprinted London: J. M. Dent, 1912, pp. 492-97.
[119] See 2.5.2.2.
[120] A '*mass of contradictions'* Cecil as protector of his monarch, was nonetheless allowed unprecedented influence on policy. Alford, S. *Burghley*, New Haven: Yale University Press, 2008, p. xiii.

[121] Hulme (1900) p. 53.
[122] Harington, J. *Metamorphosis of Ajax*, London: Richard Field, 1596, p. 116.

control for the weaving sector. To be in control of such inchoate technology provided an *ab initio* advantage to a new manufacturing class, now linked to merchants and rural gentry, agreeably positioned with substantial representation in the Commons.

In this environment, and perhaps due to unusually acute court rivalries and financial difficulties of the period, a system of abuse, one potentially ever-present in commercial activity, seeded under Tudor and Stuart monarchs and became enlarged and increasingly significant, not least in providing a means of raising revenues for the Crown.[123] Therefore what has been referred to as a comprehensive strategy of both increasing Crown participation in, and supervision of industry, culminated in an intended policy of inducing innovation in general rather than invention *per se.*[124] Letters patent evolved, such that the holder received sole rights of *selling* certain commodities or exclusively engaging in certain areas of trade. This included the importation of inventions. Therefore, what had legitimately evolved as an inducement for public benefit became a system of protecting monopolies in ordinary trades that were already performing healthily.[125] A facilitator for this occasional 'stimulus' was the convenient bye-product of the preservation of political power by means of regulating industry in tandem with national objectives; a reality that only fell at the later fence of the lucrative licensing patents. Consequently, workers already *in situ* would be disenfranchised by modest improvements.[126] A similar fate could afflict larger concerns. That the legacy of a written transfer of technical detail remained in abeyance in improver activities was so demonstrated by the requirement that models be made for the determination in Humphrey's 1565 case by the Court of

[123] Neither Cecil nor his queen can be blamed for presiding over the beginnings of a corrupt model; rather they were *in situ* as it imploded.
Wool, wool fells, leather, lead and tin could only be exported from 'towns of the staple'. Such restrictions reduced the probability of customs evasion. However, one Statute (Calais: Company of Merchants of the Staple, 27 Hen. VI c. 2) despaired at the decrease of customs 'by reason of licences granted by letters patent and by misuse thereof.' The contradiction is completed however due to the long list of exceptions available to the sovereign, and as the Appendix to the 48th Report of the Deputy Keeper of the Public Records (1886-7) states (p. 218) from an inspection of the French Rolls, it is clear 'he fully availed himself'.
It is inaccurate therefore to commence a study of the abuses assumed to have triggered the Statute of Monopolies with the Tudor era. Rather, one must go back some fifteen decades earlier.
[124] Boehm, K. Silberston, A. *The British Patent System*, Cambridge: University Press, 1967, p.14.
[125] Rich, G. S. Are Letters Patent Grants of Monopoly? *Western New England Law* Review, 1993, pp. 239-56 at 242.
[126] Although not permitted by the Privy Council in Matthey's case (1571) as the applicant could but 'show…a light difference of invention'. 74 ER 1139; Noy 183; 1 Web Pat Cas 6.

Exchequer.[127] Citing (a non-referenced comment by Coke), Hulme noted that, in part; the patent was not upheld on account of prior use.[128] Turning anticipation on its head, in a principle which sustained until the 1700s the pair of grants licensed, in the ultimate denial for the submission of a written description, covered 'all subsequent inventions of the patentees' [129] in this area of metallurgy.

2.5.3.2 The petitioner has landed

We are still missing one connection and this was the expectation that an inventor would secure a reasonable period to profit from their technological advance. While this came to be the foundation-stone on which subsequent abuses were constructed, it obviously had validity and could provide security to invest time in non-standard pursuits as well as being a motivational force in its own right. This sense of entitlement has had many echoes over time, triggering changes to British patent laws endowing effective protection for inventors.[130] But from where did the roots of the latter first find purchase? Was there any requirement to provide a formal written description in exchange for a term of market exclusivity? We must remain with Elizabeth's reign to find the answers.

Figure 2.3 shows a special licence granted to one James Acontius Tridentinus (Giacopo Acontio), an Italian lawyer and engineer who arrived in 1559 and is credited with being the first to have argued successfully for the establishment of the patent system in England,[131] providing the impetus for the protection of patents of invention which has not just endured, but has colonised the common law jurisdictions and its peers. This licence arose on foot of a petition which he had apparently made shortly after his arrival.[132] In his petition, Acontius

[127] Summarised in Hulme (1896) p. 148. Noy 183; 1 Web Pat Cas 7.
[128] *Ibid*.
[129] Hulme, p. 148.
[130] On becoming an independent instrumentation contractor to Glasgow University, possibly facilitated by the guild detractor Adam Smith, James Watt embarked on the patenting of his inventions, latter triggering legislative response to his actions. Gribbin, p. 250.
[131] Hulme (1896) at pp. 148, 151.
Seaborne Davies, D. in: Acontius, Champion of Toleration, and the Patent System, *Economic History Review*, 7, 1, 1936, pp. 63-66 also attributes substantial credit to Acontius as the first man in England to '*enunciate a systematic and philosophical justification of religious toleration'*.
[132] Aside from some uncertainty around dates associated, there is also the curiosity that Acontius had been 'talent-spotted' in Paris by Sir Nicholas Throckmorton. This ambassador to France, having survived trial for treason five years earlier, recommended Acontius to Cecil after the latter had been seeking Italian engineers to improve the fortifications at Berwick. White, L. Jr. Jacopo Aconio as an Engineer, *American Historical Review*, 72, 2, 1967, pp. 425-44 at 431.

stressed the advantages of fostering invention. With the benefit of hindsight, the petition appears to be a gamble, in that it is much more concerned with the lot and burdens of being an inventor. So, while it is quite recognisable as an appeal for a (albeit useful) monopoly and is, in that sense, replete with sentiments similar to the abstract of a patent application of today, as a seed, it could easily have landed on fallow soil. The bet seems to have paid off, yet the passages below suggest little by way of enduring benefit in the form of a written reduction to practice for following practitioners.

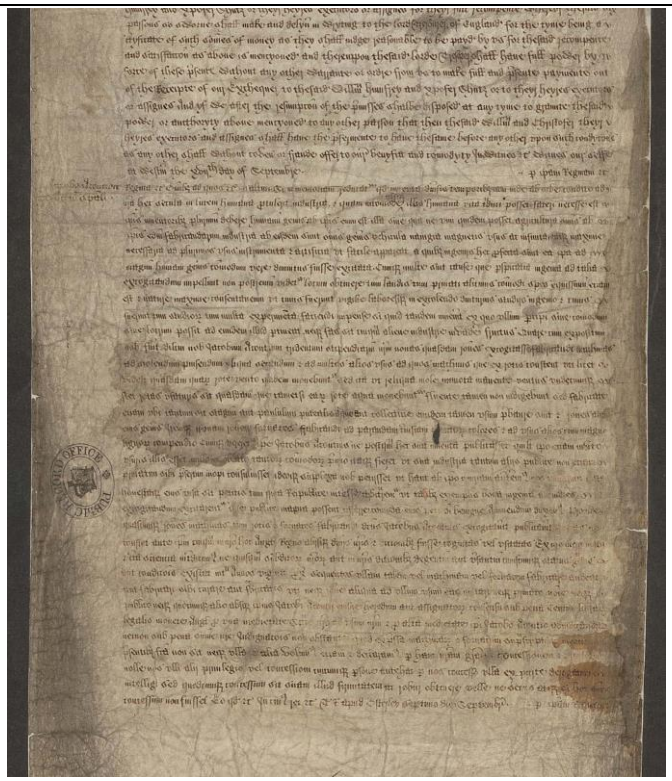

Figure 2.3

Special licences for James Acontius, 7 September 1565

(Photographed from original roll C66-1017 m. 47 held at TNA)

> *'…Whereupon, since it has been revealed to us that… Acontius of Trent,...had thought up certain new methods of constructing machines for grinding, crushing, cutting wood…, where the wheels will actually be moved by the wind, but in such a way that, while the rest of the structure stays unmoved, the wind, wheresoever it may blow, will turn the wheels, and other cases, where, although their wheels will be moved*

by water, nevertheless they will not need it to be flowing,…; and likewise a new method for constructing furnaces…with a great saving of wood.,…and because we thought it to be of interest to the state that by such examples good ideas from day to day should be caused to be thought up, which can publicly offer great advantages, and we have decided to give our assent kindly to his petition By the queen, herself.'[133]

2.5.3.3 A paradigm shift for patenting

So protection was now granted for what were essentially new methods for producing machines. At least until the Stuarts reverted to the late Tudor-inspired industry-wide monopolies, this represented a distinct advance from the aforementioned grants. Tellingly, each of Schiedamme, Utynam (grantees from the fifteenth century) and Acontius were not just artisans seeking domicile, but immigrant innovators. Utynam may not have been the actual inventor of the process[134] whereby coloured glass could be produced, but the exclusivity afforded to him for a 20 year period and his obligation to instruct others in his art so they could independently practice the techniques thereafter, makes his grant stand out as instantly recognisable today.

Yet Acontius' grant further elevates this paradigm through its recognition of his role as inventor of new mechanical processes. He had certainly divulged additional information compared to the previous foreign patentees or the native Smyth grant; however, it scarcely represents anything other than modest additional written disclosure. While the description provided falls short of being enabling, nevertheless, the incremental nature of such exchange means this grant is regarded as a milestone in that an inventor applied for and was granted, a patent for an invention. Acontius' petition (Figure 2.4) had requested:

[133] Transcription and translation by Harrington, D. FSA FSG LHG, History Research, Kent CT 18 8JA. The attenuated (English translation) Calendar of the Patent Rolls *7 Elizabeth I: Part IX p. 331* concludes with this additional statement. 'At his suit: it is right that inventors should be rewarded and protected against others making profit out of their discoveries.' This curious addition does not seem to be a part of the membrane entry, which is the last on its roll (membrane no. 47 of 47). This is noteworthy given the latent confusion about the dates of the petition and subsequent grant.

[134] In England, or at least until 1977, patents continued to be issued to the first to introduce (and practice) an invention not previously disclosed.

'I have discovered most useful things, new kinds of wheel machines, and of furnaces for dyers and brewers, which when known will be used without my consent, except there be a penalty, and I, poor with expenses and labour, shall have no returns. Therefore I beg a prohibition, against using any wheel machines, either for grinding or bruising or any furnaces like mine, without my consent.'[135]

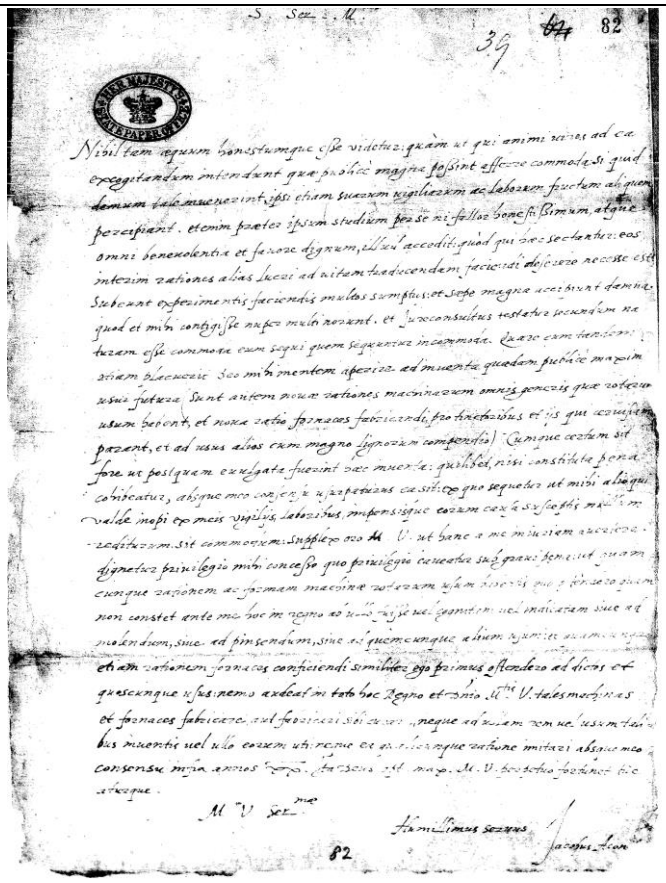

Figure 2.4

Petition of Jacobus (Giacopo, James) Acontius, SPD 1601-03.

(Photostat from microfilm held at TNA)

Hulme defines this as the seminal moment in the transfer of the responsibility for the introduction of new industries to the realm from the Crown to the patentee.[136] Yet in pursuit of such benefit it may be concluded that the Crown had wantonly abrogated an opportunity to contemporaneously draw-down the undoubted benefit of a full written disclosure from the applicant. By deciding that Acontius' petition

[135]SPD: Eliz. I. 1601-1603 (Incl. 1547-1565 Addenda), December 1559, ix, 39) p. 495.
[136] Hulme (1896) p. 151.

was reasonable, Elizabeth inaugurated the English policy of systematically rewarding inventors for their ingenuity.[137] As yet however, there was still no parallel responsibility to make a clear and unequivocal disclosure of the claimed invention.

2.5.3.4 A route well-travelled unbalances the prerogative

Notwithstanding this neatly encapsulated description of the genesis of the patent system in the common law landscape, there remain residual elements. Firstly, it could be seen as a partial catalyst in the erosion of the notion of the sanctity of the monarch's prerogative. In essence the Commons would shortly become increasingly strident is shaking off the manacles imposed by traditional perceptions of the source of power. Contemporaneously, Acontius was close to the vanguard of a newly emergent pattern of grants of exclusivity; many for foreign importers. With opportunity becoming concentrated in the hands of few, not everyone would be content to remain in the position of being a humble petitioner of the queen's grace. This emergence tends to be primarily associated with the frustrated reaction of the populace to the infamous abuses of the era, where well-positioned subjects (e.g., Darcy, see later) were indulged with grants when they had neither originated anything of value nor performed anything of service to the community save themselves.[138]

Reflecting on this lawyer-cum-religious philosopher–cum-engineer's *Satanae Stratagemata*, Phillips noted the disparaging perspective towards his peers and wondered: '[I]s this opinion reflected in his desire for patent protection for inventors?'[139] It is not a little curious that Acontius arrived in November 1559 and within the month was petitioning the Crown, as the given date for the request was

[137] Foster, F.H., Shook, R.L. *Patents, Copyrights and Trademarks* 2 edn. New York: Wiley, 1993, p.6.

[138] The notion of dissent was becoming established in any event, but for reasons of belief not opportunism. Some six years after the 1587 conspiracy to overthrow Elizabeth and restore Catholicism, parliament enacted statutes to deny future protests from Separatists, Catholic and Puritan dissenters e.g. "*An Acte for the Restreyning of Recusantes to Some Certen Places of Aboade*" 35 Eliz. I. c. 2. §2. 4.

[139] Phillips, J. (1982) at 78 (attempting to disentangle the precise dating).
Records at TNA summarise his tenure as having 'an annuity of 60 *l* granted 27 February, 1560, letters of naturalisation, 8 October 1561 and a licence to take up workmen to amend Plumstead Marshes, 24 June 1563, but not the patent here solicited.' (SP 15/9/1 f.82. SPD, 1601-03 (Addenda 1547-1565) 1559 Dec. p.495). A salient consideration is that these archives (State Papers Domestic) of the principal Secretaries of State were only brought together in the nineteenth century.

December 1559. Subsequent to seven years at the court of Charles V and having then renounced Catholicism in 1557, he fled from Italy to Basle, then Zurich, Strasbourg and subsequently England.[140] With two other "*dependtori*" Acontius may have been the recipient of a patent in Venice in 1545 for devices for powering mills and draining marshes, (these being talents he practiced later in England) under that city's 1474 patent law.[141] There may also be an additional consideration: occasioned by such mobile technologists who could potentially circumvent the inability of a government to deny potential exploitation relating to petitions for protection for inventions not yet encased within the framework of a full written disclosure.

2.5.3.5 Seeing still believes

All of a century earlier, a patent granted by the Venetian Senate in 1443 on foot of a petition from Frenchman Antonius Marini, contained the following codicil:

> '*…* [*I*]*t shall be granted and done and aforesaid, and letters and records be made out in proper form; however it is also ordered,…that a test (experienta) shall be made with said mills in one borough. And if it appears to the government that the matter is successful and that it can have effect, the other mills shall be erected also,...*'[142]

This was a grant neatly sandwiched far-back between those in England to the pioneer in salt water evaporation, John of Schiedamme and John of Utynam the glazier.[143] The fact that Marini was an alien and the fact that he claimed no inventiveness *per se* may have provoked the requirement to disclose the invention albeit by way of a test (*experienta*). There is also the possibility that this particular

[140] This mainland trading route terminated in Flanders. Technologies ultimately granted letters patent in England, migrated from Italy, accompanied by the ideals of the system of rewarding inventors with periods of exclusivity.
[141] *Depentori*; he who portrays or describes; Phillips suggests a metaphorical 'he who conceives'. Phillips (1982) pp. 76-77.
[142] Mandich, G. Venetian Patents (1450-1550), *Journal of the Patent & Trademark Office Society*, 30, 3, 1948, pp. 166-224 at 172-73. His update, Mandich, G. Venetian Origins of Inventors' Rights, *Journal of the Patent Office Society*, 42, 1960, pp. 378-82 at 379 gives the date as 1444 (the Venetian year commenced on March 1).
[143] 1440 and 1449 respectively.

requirement merely represented the latest stage in a ripening evolution from earlier official articles of enticement offered to foreigners with desirable skills.[144]

Prior to Speyer's patent; there had been a concentration of mineral grants issued spanning the period 1409 to 1443 which could be withdrawn for want of failure to utilise them.[145] Later the Senate granted a petition in 1460 to one Master Guilelmo from Lombardy who had applied by:

> '*setting forth among other things that he has skill and experience in the building of cook stoves for dye shops, in which one-half of the wood is burned that formerly was required.'* [146]

The Senate added, in impressive anticipation of the latter importance of the role of the bargain they were entering: 'Our General Welfare Board (Provveditori di Comun), pursuant to the test, found it exactly so; also that it will inure to the benefit of the public to have the types of stoves aforesaid.'[147] The similarity between the wood-saving stove and the superimposable application of the technology (furnaces for use in dying materials) to that applied for by Acontius in England a century later, is difficult to overlook.[148] As the first importer, if not inventor, his grant of letters patent by the queen on the advent of a new technology was entirely compatible with the actions of Elizabeth's predecessors, yet affirms the inadequacy of any policy instrument that sought to enhance national technological capability without the benefit derived from a written store of instruction.

The actions of this new immigrant may not have been quite so benign and this less than open behaviour, or at least someone later submitting replica technologies for consideration, could have been intercepted through the presence of a system of adequate recording of working principles of the invention. In the new

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[144] Mandich (1948) p. 171 cites an ordinance of the Cabinet of Venice from 1272: "Any one who comes to Venice to exercise the trade of a wool weaver shall receive a house to live in and to exercise said trade…free from cost to him for 10 years." State Archive of Venice: Compendium of the General Welfare Board, Vol. 1, p.4 r., August 3, 1272.

[145] This cluster of grants is not regarded as patents of invention. There may have been the handicap of an absence of prestige for those from a trades' background especially if the crafts concerned were traditional (unlike the recent advent of printing).

[146] *Sen. Terra* (Mainland records of the Senate) reg. 4 p. 152 (1460, Aug. 24).

[147] Mandich (1948) p. 167 reports the prevalence of words such as *literae patentes, privilegium* and *monopolium.* In relation to the 1624 English Statute of Monopolies it is interesting that the latter of these three terms did not exist in the Latin language.

[148] Mandich (1948) p. 219 gives a summary of the earlier Venetian grant to the three '*depentori*'. 1544 Ven. St., January 15 (*S. T. r.* 33 P.176) Jacomo Antonio from Trento, Jacomo from Trento, and Jacomo dal Porte di Bassan, painters, obtain a 25-year patent for certain mills of theirs.

era of print, is difficult to reconcile that an invention conceived in Venice took all of a century to reach an England, albeit now with a queen's counsellor *in situ* who was desperate to elevate the nation's store of technical expertise. Nevertheless, in the special (English) licence for Acontius issued on 7 Sept. 1565 (just ten days before the grant of Humphrey's licence), there is mention of '…there were costs both of studies and in doing many experiments…' Yet there is no evidence that he was required or offered to submit to a test. The English system, still in its infancy, had no formal mechanism to appraise the veracity of the claims being made.[149] The reluctance to replicate the Venetian regime of evaluation is noteworthy. Given that over the decade following (1561-70) six patents were granted for mechanical inventions, this seems strange, but less so when compared to the statistic that twelve grants were made in the field of chemistry.[150] These presumably would have been much more problematic to reduce down to experiment and/or a written description of the relevant process or product.[151]

2.5.3.6 What consideration was available for endeavours close to the Crown or the Lord Protector?

Almost superimposable on this affair was the scandal of the metallurgist Daniel Houghstetter's grant of 1564.[152] His petition[153] had proclaimed his preference to keep his secret to himself for fear of infringement if he were to publish without the cover of protection. A complication was that phenomenal quasi-judicial powers and privileges had been devolved to the operators of these '*mines royal*'. A six-year royalty of ten percent underpinning this chronically wasteful monopoly was earmarked, yet enormous losses were realised with one of the patentees applying for debt relief. The sting in the tail was that the Crown continued to have an expectation that a patentee would, within a limited time, endeavour to satisfy any undertaking announced in a petition that the inventive advance would help to

[149] This did not arrive until the coming into force of the Patents Act 1902 subsequent to the Fry report.
[150] Price, p. 8.
[151] See also 6.3.2.2.
[152] Calendar of Patent Rolls: 6 Eliz. I. pt. 3. This grant was in favour of Thurland and Houghstetter, the latter being of German stock.
[153] SPD Eliz. I. 36, 95, quoted by Seaborne Davies, D. The Early History of the Patent Specification II, *Law Quarterly Review*, 50, 1934, pp. 86-109 at 99.

realise a new trade for the realm and 'to secure the memory of this invention' and furthermore, to 'make certain that the knowledge of it should remain known to our people'.[154] In the absence of a formal concept for lasting technology transfer this legacy was inevitably on a path for disappointment.

At the other end of the privilege spectrum a clause might be inserted into a grant for the purposes of prevention of non-use or misuse of the conferred benefit.[155] Such a failure was likely to fall under the umbrella heading of 'inconveniency' potentially resulting in a revocation, this made under the Sign Manual or one of the Royal Seals, of some exposed grants, especially during that period of agitation against monopolies as the seventeenth century dawned.[156]

A further expediency to erase public discontent and one more pertinent here was the 'apprenticeship clause'. This manoeuvre imposed a limit on the participation of non-native personnel and thus carried forward the objectives of the early letters patent that had originated with enticements introduced by Edward III (and sporadically sustained thereafter)[157] where a pedagogic heritage was expected. This covenant was to continue to subsist across the Elizabethan era. However, by the Restoration, the individual patentee for industrial purposes had been augmented by larger partnerships from who little was likely to be demanded in terms of disclosure.[158]

Nevertheless, a fuel-saving grant to George Manby in 1650 anticipated a rapid sufficiency of salt manufacture 'without the help of Foreiners'.[159] As an article complementary to the patent itself, an indentureship might even be regarded as the forerunner of the later specification. The importance of this condition may be gleaned from a grant to Jeremy Buck, which, in a reflection of the perspective of the Interregnum with the Great Seal now defaced and replaced with the Commons'

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[154] Seaborne Davies (1934, II) p. 99 citing recitals in patents to Synerston (1573) 15 Eliz. I. p. 5 and the new Art Society (1575) 17 Eliz. I. p. 9.
[155]Including lack of novelty. *Ibid.*, pp. 102, 104.
[156] *Ibid.*, p. 103.
[157] The Statute of Artificers of 1563 (5 Eliz. I. c. 4) had attempted to regularise labour on a national basis with apprenticeships (amongst other stipulations) to last seven years, as in London. This enduring arrangement favoured corporate, as opposed to market towns. Another effect was to carve out a disadvantage for immigrants in their ability to compete with native artisans.
See Cunningham, pp. xii-xiii, 22-37.
[158] MacLeod, C. *Inventing the Industrial Revolution*, Cambridge: University Press, 1988, p. 13 has noted the exception of the White Paper Company and the Royal Lustring Company who had impositions placed upon them such that native apprentices be instructed.
[159] Jenkins, R. The Protection of Inventions during the Commonwealth and Protectorate, *Notes and Queries*, 11 S. VII 01 March, 1913, pp. 162-63.

stamp, received protection by Act of Parliament directly.[160] Buck's award was for the smelting of iron with coal[161] with a condition of this Commonwealth patent that:

> '*after seven years of the term do and shall take apprentices and teach them the knowledge and mystery of the said new invention*'[162]

In an era when new machinery was viewed with suspicion as the ruination of traditional skills, it is noteworthy yet again that the mechanism of transfer remained unclarified. There was thus no adequacy of description. It is small wonder that decades of ruinous persistence in addressing the roll-over of technical challenges posed by the extractive industries in particular were to be wasted.

Viewed from the other side of the patent-bargain, and for the purposes of needing to contradict trenchant views that patents were inimical to the traditional economic freedoms of the citizenry, rulers needed clarity that any special privilege was for the overall benefit of the nation. Shorn of the certainty of invention provided through a written document, such oversight was impossible. From today's perspective this omission appears remarkable. Yet, the significance attached to procuring the disclosure safeguarded within a written description was still not apparent several decades after the Statute of Monopolies. Given that apprenticeship was the recognised route to securing a trade it was an ongoing assumption that the patentee would work their 'new manufacture' as a 'new trade' through the effort of their apprentices, who would later be free to conduct that mystery themselves.[163]

In relation to petitions for grants, any disputes over novelty, pursued through a submission of caveats to the Law Officers might result in hearings to

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[160] *Ibid.* Jenkins lists eighteen patents of invention from 1643-1658 noting that the 'Printed Indexes of the Patent Office contain no entries for the period between the years 1642-1660.' The Civil War opened in 1642 and Charles I was executed in January 1649.

[161] His enterprise involved Cromwell, made three attempts, but failed. Galloway, R. L. *A History of Coal Mining in Great Britain*, London: Macmillan, 1882, pp. 48-49.

[162] Commonwealth Act AD 1651, c. 2. *Act concerning the new Invention of melting down Iron and other metals with stone-coal and other coals, without charking thereof.* [C.J., vi, 555; Scobell, ii, 153.] Printed, Vol. ii., p. 509.
From: Firth, C. H. Rait, R. S. (eds.) 'Table of acts: 1651' (02 April) Acts and Ordinances of the Interregnum, 1642-1660 (1911) pp. LXXXII-LXXXVII.
URL: http://www.british-history.ac.uk/report.aspx?compid=56683

Accessed: 24 October 2016.

[163] Wallace, R. W. Williamson, J. B. *The Law & Practice Relating to Letters Patent for Inventions*, London: William Clowes, 1900, p. 160.

provide a determination;[164] but the requisite knowledge was frequently in abeyance before such luminaries. In the absence of the clarity that a written description would surely provide, this situation was to continue, with one prescient patentee advocating a special court to decide such matters for the mineral and metals sectors.[165] An application by John Garill in 1663 passed all stages up to the Great Seal but the Gold-wire Drawers of the City of London then objected. An order was issued that the Lord Chancellor not permit the sealing. Upon request, Garill refused to disclose his process unless the patent was first sealed. Hulme reports that the proceedings then ended abruptly and the secret died with the inventor.[166]

More insidiously, in an expression of merchants carving out industry-wide dominance, the status of apprenticeship may have provided some cover for the inception of deceptive monopolies at this time.

2.5.4 Liberty on the Bounty

Proclamations in book form assume the status, if not the force, of law.

Queen Elizabeth had miscalibrated her subjects' tolerance of monopolies and was forced to sue for penance; submitting to the Commons in 1601:

> '*…And if my Princely bounty have been abused, and my grants turned to the hurt of my people contrary to my will and meaning...*'[167]

The continuing association of Crown grants of privilege[168] with the exclusion of competitive trade, increasingly exorbitant pricings, all combined with blatant profiteering for everyday goods, was unsustainable and became, *inimical to the common weal*.[169] Attempts to appease the populace were ratified *via* proclamations

[164] A legal device, initiated (and renewable for a fee) in attempts to pre-empt sealing by requesting to be informed of patent applications in a particular discipline.
[165] Seaborne Davies (II, 1934) p. 107.
[166] Hulme, E. W. Privy Council Law and Practice of Letters Patent for Invention from the Restoration to 1794 Part I, *Law Quarterly Review*, 33, 1917, pp. 63-75 at 65-66.
[167] The 'Golden Speech' to her Last Parliament, 30 November. In this act of contrition, Elizabeth acquiesced to the wishes of the Commons, submitting that the granting of monopolies under the Royal Prerogative had been in good faith and that she would not allow them to injure her subjects.

[168] A common-law, not a statutory right.
[169] Gomme, A. A. *Patents of Invention: Origin and Growth of the Patent System in Britain*, London: Longmans, Green and Co., 1946. p. 14.

of James I in 1603,[170] 1610 and 1621.[171] From this crop, that printed in 1610 laid the foundation for the subsequent Statute of Monopolies.[172] The former ordained that monopolies for industries already in existence were illegal while the latter became the primary legislation for patents for invention, and begat the phrase '*the first and true inventor*.'[173] In the absence of a vehicle for recording a patent specification this concept would remain devoid of the means of assessing anticipation.

2.5.4.1 'Metempsychosis[174]; how the law adapted to technological progress and the evolution of an environment demanding new embodiments'

Coke described these proclamations as the primary response to *The Case of Monopolies,* most notably in 'The King's Book of Bounty'.[175]

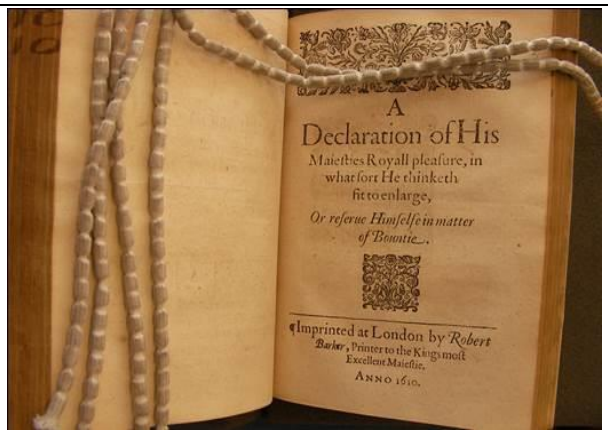
A
Declaration of His
Maiesties Royall pleasure, in
what sort He thinketh
fit to enlarge,
Or reserue Himselfe in matter
of Bountie.
Imprinted at London by Robert
Barker, Printer to the Kings most
Excellent Maiestie.
ANNO 1610.

Figure 2.5

The King's *Book of Bounty*

Early Printed Books Repository, University of Dublin.[176]

[170] 7 May, '*A Proclamation inhibiting the use and execution of any Charter or Grant made by the late Queene Elizabeth, or any kinde of Monopolies, &c.'* SPD Jac. I, i, 68-70.
[171] 10 July, '*A Proclamation declaring His Majesties grace to his Subjects, touching matters complained of, as publique greevances.* SPD Jac. I, cxxiii, 122 (24 Nov. 1621) & cxxiii, 134 (28 Nov. 1621).
[172] Enacted in May 1624; *An Act Concerning Monopolies and Dispensations with Penal Laws and Forfeitures Thereof*, 21 Jac. I. c. 3.
[173] Coke, Sir E. *Institutes of the Laws of England, Third Part*, Cap. LXXXV, London: E. & R. Brooke, 1797, pp. 184-85. Monopolies were declared contrary to law and void. Exceptions were provided for the authors of new inventions, not exceeding fourteen years (two apprenticeship terms).
[174] Seaborne Davies (1936) p. 65; transmigration as a new embodiment of an older idea.
[175] King James I, *Book of Bounty. A Declaration of His Majesties Royall pleasure, in what sort He thinketh fit to enlarge, Or reserve Himselfe in matter of Bountie*, Robert Barker, London: 1610, 32 pp.

What is more pertinent is that the king's book laid the ground for the Statute some thirteen years later. As Price described it:

> '[T]hough *legislation subsequently became necessary, this was not to supply a deficiency…, but to reassert the law which was being neglected, evaded, and defied.*'[177]

Given this multiplicity of rejoinders, and seeing them listed in sequence we can scarcely feign surprise at the machinations at Court and Coke in particular, as he attempted to manage the legislative environment in the lead-up to the passage of the Statute of Monopolies. For he undoubtedly sought to balance the mindset of legislators, the demands of their constituents, the potential interpretations of the judges, the prerogative of the monarch and, his own (Coke's common law) legacy; and all this compressed into a shorter time frame than the normal circumstance of a law being passed by one generation of legislators yet its mettle not being felt until succeeding generations were *in-situ.* The question arises then; given the absence of a mechanism for disclosure of invention, was the legislation a suitable harbinger of patent enablement? Put another way, given the role of his *Reports* in educating future generations of common lawyers, the patent historian must deploy scrutiny in differentiating between personal opinion and public record. This is far from a moot point given the absence of any requirement to record technical specifications in order to confer an invention on the public at large. That the acceptance of some vague description of the nature of a technical subject seeking patent protection was to persist for another nine decades[178] seems extraordinary today[179] yet given the immature status for modes of delivering the written word (especially for a craft and other than through apprenticeships) is understandable.

The indistinctiveness of expression insulated within sixteenth century English technical literature that was now at last being corralled by Ramist

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[176] This copy of the 1610 edition from the 'Early Printed Books Dept.' of Trinity College, Dublin (*Pamphlets* vol. DD. kk. 18 (no. 7 of 11 pamphlets in this binding)). There also exists a 1619 edition.
[177] Price, p. 24.
[178] Until Nasmith's patent GB 387 [1711].
[179] After a triumvirate of earlier indexes, Patent Office Superintendent Bennet Woodcroft's next contribution was the 1855 *Reference Index* where the patent historian may source citations in such as trade/technical journals and also be directed to the office of enrolment where any drawing or description had been filed.

tabulations may be overstated[180] yet the resultant 'lack of an obvious unity'[181] in some Middle English vernacular collections highlights potential difficulties in the provision of efficient modes of technical communication. Such incoherent multiplicity of language was also being felt close to the seat of government just as the perspective that 'equity was the exercise of the king's conscience'[182] was bonding within the psyche of the increasingly exasperated monarch.

A new dynamic had been ushered into both public and private policy. Given the ongoing turmoil in dialogue a modest requirement for submitting a description of an invention would not have appeared particularly necessary. In an era when print was displacing personal factors in communication, rampant exaggeration or sophistry might be identified more readily from oral communications. Of necessity this was where everyday parliamentary oversight was focussed. Subterfuge of a technical form would be more promptly detected from written utterances but would not be within the ambit of the non-expert. Furthermore, once written down and printed, an idea was fixed, uncontrollable and incapable of confinement.

Returning to more deliberative affairs of state, some self-censorship also inevitably abounded as anti-prerogative opinions were more likely to be 'safer in the mind than on paper.'[183] Whatever the disclosure, these realities were becoming the contribution of the written word in a dragging of the monarch's prerogative towards an upheaval where it was intersecting with parliamentary muscle-flexing and rebellious fervour directed against unfair monopolies.

2.5.4.2 Patent rights vs. equitable remedies

For the body politic demanded, if not an unfettered access to supply goods and services to society, then an equitable remedy to the abuses of monopolies. This can be confirmed by considering the prominence (number one) assigned to this component of the restrictions ('*Things contrary to Our Lawes*') proposed in James' *Book*. Yet, inventive activity and products/methods arising therefrom were cast in

[180] Robbins, p. 413.
[181] Getz, p. 441.
[182] Thomas, G. W. James I, Equity and Lord Keeper John Williams, *English Historical Review*, 91, 360, 1976, pp. 506-28 at 515.
[183] Baker, J. H. The Common Lawyers and the Chancery: 1616, *The Irish Jurist*, 4, 2, 1968, pp. 368-92 at 368.

an altogether different light from monopolies, being recognised as crucial to future prosperity.

A selection from the twelve disallowed actions listed[184] included:

1. *Monopolies*
6. *Licences to Import, or Export commodities prohibited by the Law or any Lawful commodities, without paying the due Custome.*

In the subsequent Schedule or 'Memorial':

'*those suits wherein we are contented to bee moved by Our…Subjects, and to reward them according to the particular merit of the Suitor'*

is listed at no. 9:

'Projects of new invention, so they be not contrary to the Law, nor mischievous to the State, by raising prices of commodities at home, or hurt of trade, or otherwise inconvenient.'[185]

From the perspective of opening a policy debate on protecting inventiveness, the Book worked as it appears at face value. However, it was much more than this and it was less successful in its subtle attempts at maintaining suzerainty by the monarch. The fact that the medium chosen, a book,[186] indicates that communication concerning policy could henceforth reflect the appetite and enhanced capacity amongst society for the written adumbrations of the executive.[187]

Of interest here is the dearth of case law, at least to this point, it continuing to be reflected in the absence of a medium for defining an inventive advance. It is cathartic for the patent historian to be positioned at the nexus of the Case of Monopolies,[188] the response of the establishment (the Book of Bounty)[189] the perception that this was inadequate (the Commons and the 1621 Parliamentary

[184] King James I, *A Declaration….. in matter of Bountie*, op. cit., *pp.* 13-16.
[185] *Ibid.*, p. 21.
[186] Admittedly still a neophyte medium as indicated, in the case of surviving versions, by its binding with miscellaneous other pamphlets. There is also conjecture as to its apparent printing in octavo format but compilation as a small quarto.
[187] The exact motivation remains unclear as proclamations were retained by the Stuarts in seeking to amplify fallacious aspects of their prerogative. Price, p. 44.
[188] *Darcy* v *Allin* (1602) 11 Co Rep 84 b, No 178, 77 ER 1260 (1603); Moore 671, 72 ER 830 (1603); Noy 173, 74 ER 1131 (1603) 1 Web Pat Cas 1; 1 HPC 1.
[189] King James I, *A Declaration….. in matter of Bountie*, op. cit., (1610).

censure of well-connected patentees)[190] and the next step (the Statute of Monopolies).

It is extraordinary that the kernel at the core of the meaning of invention has indeed persisted[191] given that:

(i) whether convenient or not for the monarchy, the word monopoly may lack a very precise legal significance;[192]

(ii) *in the amplitude of its application*[193] there were insufficient prior cases such that the boundaries and latitude of the preceding common law would not have been sufficiently interrogated thus far;

(iii) there was a consequent deficiency in the knowledge *of the general rule expressing that state of the law*[194] which might be expected to be reflected from a series of judgments attempting to discriminate between the facts arising from similar, yet different cases.

For this was not idle conjuration. Among the paucity there was in the matter of the *Alton Woods* Case[195] the issue of those consequences should be the king not be fully appraised: '[A] false recital of a thing not parcel of the consideration does not vitiate the King's grant' and '[L]etters-patent, with the words *ex certa scientia*, *&c.* are to be construed beneficially for the grantee, according to the King's intent expressed in the grant, unless the King is deceived in his grant, or his intent cannot by law take effect; and such a grant is to be construed according to the proper signification of the words.' These principles built on the more complete phrasing:

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[190] Proceedings against Sir Giles Mompesson (1620) 2 St. Tr. 1119.

[191] Some recent common law reliance on the Statute of Monopolies includes (Australia) *Bristol-Myers Squibb Co* v *F H Faulding & Co Ltd* [2000] FCA 316 (22 March 2000); *D'Arcy* v *Myriad Genetics Inc* [2014] FCAFC 115 (5 September 2014) and (United States) *Bilski* v *Kappos* 130 S. Ct. 3218 (18 June, 2010). The recent changes in Australian patents legislation (*Intellectual Property Laws Amendment (Raising the Bar) Act 2012*) should help ensure greater consistency with other major patent jurisdictions with the requirement that specifications clearly describe the *utility* of the claimed invention.

[192] Gordon admits it was a term of law but felt (in 1897) it was '*now antiquated and perhaps obsolete*.'
Gordon, J. W. *Monopolies by Patents*, London: Stevens & Sons, 1897 p. *vii*. It remains a durable possession however as held by Kitchin J in: *Generics (UK) Ltd v Lundbeck A/S* [2007] EWHC 1040 (Pat), [2007] RPC 32 at [235]. '...
A patentee cannot seek to bolster the inventive nature of his monopoly by relying on a discovery which he had not made at the time of the patent. ..Those discoveries…could not have been predicted from what is described…'

[193] Freeman, M.D.A. *Lloyd's Introduction to Jurisprudence*, 9th edn. London: Sweet & Maxwell, 2014, p. 221 quoting Bentham, J. '*Of Laws in General'*.

[194] Amos, S. The Sources and Interpretation of Law in: *The Science of Jurisprudence*, London: Longmans, Green, and Co. 1872, p. 58.

[195] *Alton Woods*, Case of (1600) 76 ER 89, 1 Co Rep 40b.

'…a false recital of a thing in a patent which sounds to the King's benefit, avoids the grant, yet a false recital of a thing *in pais* executed and not material, does not hurt; …a recital which is true in terms is sufficient.'[196] Finding solace outside the confines imposed by written or tangible evidence retained some breathing space but would eventually prove unsustainable. Ultimately, while questions around the process and construction of a grant would dissipate, once the grantee was required to submit a specification to scrutiny, it was inevitable that the format for this account would be dissected for sufficiency, a formula wholly dependent on the adequacy of description.

2.5.4.3 The lustre of potential abuse has no need of description

Coupled with the nonexistence of the uniformity necessarily conferred by efficient diffusion of measured variables and recorded specifications, this vacuum was exploited most efficiently by those of fortunate position. For example, in the absence of perceptible arrangements Sir Giles Mompesson MP was reportedly able to magnify the weight differential between gold purchased at 12 ounces per pound (Troy weight) and his later selling of threaded gold lace, artisanal diluted, using the rating of 8 ounces to the pound (Venice weight).[197] Although hypothetical, had there been an invention associated with this bullion-consuming patent, the abuse could have been intercepted through a quantified disclosure. The authority to prohibit new entrants to the market was itself a valuable commodity, so restrictions on this right, potentially imposed under the auspices of requirements to convey technical information in describing an invention, continued to be resisted.

Meanwhile socio-political events and scientific advance could not wait for the law to catch-up.

[196] Cholmley's Case (1598) 76 ER 527, 2 Co Rep 54.
[197] See the Belasyse Diary in: Notestein, W. Relf, F. H. & Simpson, H. (eds.) *Commons Debates 1621*, 7 Vols. New Haven: 1935, Volume 5, pp. 29-32 at 30. Also Volume 6, pp. 34-35.

2.5.5 Simon Sturtevant: a necessary reappraisal

2.5.5.1 The prototype of the specification

There remained an additional contribution to the emerging awareness of the importance of verifying a standardised minimum threshold for the description of a new technological advance. This was provided by the 1612 *Treatise of Metallica.*[198]There are several reasons why this part philosophical publication *of his Majesties Indenture* deserves mention. In adopting a Ramist motif to a decision tree flow-chart to differentiate between invention types such as '*Theoricke Inventions'* or '*Practicke Inventions'* these differences were inherent in the nature of the claimed progression. In other words, there was a formula to discern the possible incremental nature of the advance.[199] Among the 'Inventional progressions' listed were husbandry, hosiery and drinking-vessels manufacture. Reflecting the examples in this thesis, the latter included 'greene Glasse', and 'Venice glasse.'[200]

> The text described, for what it calls an invention Organicall:
>
> '*[T]he common parts are such as are borrowed from other trades, occupations and misteries formerly invented and in use, and now adjoined and mixed in amongst the new parts of the invention*.'[201]

The use of the term borrowed is striking as there was no other medium to transfer a novel technology even as late as the seventeenth century.[202]

> Earlier, he differentiated between the 'sorts' of invention:
>
> ['*A*]*n Invention is two fould, An Invention of discovery, or an invention of experiment, or an Invention is triable, or untriable.* '[203]

Through the medium of a self-penned question and answer approach, Sturtevant, in following this recurrent theme of derivatives from other trades, then provided a

[198] Sturtevant, S. *A Treatise of Metallica*: London: George Eld, 22 May, 1612. The patent was indentured on 29 February.
[199] It is worth speculating on whether he was cognisant of the potential fate of patents for 'light differences of invention' such as befell the cutler Matthey who had 'laboured greatly' yet lost his 1571 monopoly. Noy 184.
[200] Sturtevant, p.71.
[201] *Ibid.*, p.78.
[202] A repetitive phraseology in the patent mentions actions to 'make, frame, and erect…inventions…and things aforesaid…shall be transferred or converted…' with no description of how this was historically executed.
[203] *Ibid.*, p.77.

crucial lever for the future of the written description. A Theoricke Invention was associated with the:

> '*declaration of the contents thereof by a plaine and familiar description, and that either by manuscript writings or by printed treatises.'*[204]

Such an approach was foreseen by Sturtevant as necessary to comprehensively describe an invention; indicating the inception and commencement of a (as yet immature) mechanism to define novelty ('an invention in substance new') as opposed to mere innovations: 'a thing not yet practiced…within any of his kingdoms'.

It followed then that the 'practick of an Invention' was that 'which is made in reall parts and adjunct, according to the description of the Theorick….'[205] The example of a printing press helpfully suggests that the adjuncts include essentials such as ink. What exactly was defined here remains uncertain, but the patent itself critically suggests possibilities of:

> '*…the said…metals,…materials, and the means and instruments…to work and effect the same, are in some measure mentioned and expressed in the schedule…and shall be more fully, amply, and particularly demonstrated, specified, described and contained in a …treatise so to be published…*'[206]

Sturtevant, in displaying commendable insight into what was to become *de rigueur* almost two centuries later, laid out the form of the description of (the) invention, the use of models or prototypes and also the two-stage nature of a provisional specification to be filed with a petition followed by a more complete version subsequent to the successful grant. Unfortunately, the narrative progression was hostage to his circumvention of a 'simplicity of expression' a virtue that was absent to the point of rarity during writings of the era. One sociological view[207] exonerates just Camden; a just citation for the author of a tome[208] who initiated a modern approach to the necessity to evaluate sources.

Nevertheless Sturtevant had noted: ['T]he Theorick of an Invention is to be described by his parts and adjuncts that others men's labours and indeavors bee

[204] Sturtevant, pp. 75-76.
[205] Sturtevant, p. 76.
[206] A distillation using modernised spelling, from Price, p. 183.
[207] Hume, p. 251.
[208] Camden, W. *Britanniae descriptio*, London, 1586.

incroached upon or forestalled thereby.'[209] Yet similarly prophetic in forecasting the need for clarity of description in inventions, Sturtevant, in his logic for publishing this substantial manifesto listed reasons for establishing his freedom to operate in this sphere of technology:

> '*First that it might appear that his inventions are new, and of his owne devising, and not stolne from any other.*
>
> *Secondly it is fit and reasonable that that which was granted in the Pattent by generall wordes and in an implicit manner should be so specially exprest and defined, that the endeavors and Inventions of other men being different from his, might not be prevented by him.*
>
> *Thirdly that none hereafter should presume to petition or trouble his Majesty concerning any…kindes…described and comprehended in his printed treatise…, which are all priveledged businesses unto himselfe.'* [210]

Sturtevant's contribution has oft been dismissed.[211] Capvt. 1, *'The Transcript of his Majesties Indenture*' is quite vague but as described above, the subsequent schedules carve out, for patents of invention, the exemplar for the combination of the written description with the inventive act or manufacture. This analysis contributes that a denial of Sturtevant's role as protagonist for the comprehension of a panorama of materials and actions: 'the Arguments of Instruments and meanes'[212] is an injustice and his contribution should be accorded a more exalted position in the pantheon of patent history. In his zeal for procedural description he remains a curiosity, albeit not the harbinger of a policy construct.

2.5.5.2 Information remains behind bars

Perhaps his efforts were overtaken by events. Dud Dudley later described that, owing to a failure to 'perform his making of Iron with Pit-cole or Sea-cole, according unto his Engagement, King James and Prince Henry caused [Sturtevant]

[209] Sturtevant, p. 77.
[210] Sturtevant, p. 112.
[211] Among the criticisms are that it is distracting and that it be more appropriately termed the first prospectus. See Seaborne Davies (1934) p. 268 and Price, p. 108.
[212] Sturtevant, p. 76.

to tender up his Pattent.'[213] This was as early as 1613 with the first of several (also unsuccessful) replacement patents issued to competitors. Dudley then described how he, using the available coal adjacent to his father's works in Worcestershire, managed, in 1619 to produce quality iron in sufficient quantity, all to the preservation of diminishing timber stocks. The merchantable product was 'delivered unto the Tower by King James's command to be tried by all artists...' a functional test altogether necessary in the absence of a proper written description for the manufacture. This grant[214] proved to spawn a coloured history, not least because of the political affiliation of the applicant, bur most pertinently for this thesis, Dudley provides:

> [*B*]*ut the Author hath, as much as he could, avoided the terms of Art that Simon Sturtenante and others have used, which are very many. Onely the Author hath given you the common names and terms (for the most part) which are so common among Forgemen and Founders, as is nothing more common, but kept secret amongst them, and a mystery not yet known, but unto very few Owners of Iron-works…* '[215]

Fox has suggested that the grant was merely the substitution of one fuel for another,[216] but it is undeniable that a transformative and valuable advance was claimed. Nevertheless, despite earlier legislative imperatives[217] and Cecil's anxiety[218] that sea-coal be a substitute for timber-fuelled smelting,[219] it may be concluded that there remained a failure of sound policy for, coupled with an evasive, guild-like omertà there was little enthusiasm[220] to respond to Crown demands and divulge a written specification in the manner of Sturtevant[221] not least

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[213] Dudley, D. *Metallum Martis*, London: Printed by T. M. 1665, p. 60 (from 1858 reprint by G. E. Eyre & W. Spottinwoode).
[214] Lord Dudley's Patent for Iron, GB 18 [1621] actually 1622.
[215] Dudley, p. 69.
[216] Fox, p. 226.
[217] 35 Hen. VIII. c. 17.
[218] Cunningham, p. 65.
[219] '*Decaye of the woodes*' was also a feature of the Commons' debates on the glass patents where '*it was for the good of the Commonwealthe…and a reward to the first inventers of makinge them with Cole…*' on one side, with a contrary contribution that '[*T]he makinge with Coales hathe bin formerlye invented; if so by the judgment of all of no force:…*' Notestein, *et al*. May 3, 1614 p. 631.
[220] Irrespective of the hostility provoked from charcoal ironmasters, a situation exacerbated by the Civil War.
[221] Dudley's process remained secret thus precipitating a dispute (with Sir Philibert Vernatti) whence the Privy Council demanded 'sealed explanations' of the contended inventions. The latter relented and Dudley received a new patent two years later: 14 Car. I. pt. 43 (2 May 1638). Price, pp. 109-10.

when the rewards to be derived were potentially highly lucrative. Evidence for the self-interested calibration by the patentee is provided by the exemption by name for the patent in the Statute of Monopolies.[222] Furthermore, Dudley makes numerous references to challenges[223] from floods and riot, in addition to competitors seeking to have his inventions declared monopolies; at least some of these 'handicaps' could have been avoided by adequate disclosure balanced with a fair term.[224]

2.5.5.3 Going Dutch in search of freer waters

That writing about the fruits of innovation were becoming a part of the currency of written discourse may be gleaned from the later compilation of inventions, mostly on matters nautical, compiled by the Marquis of Worcester (1601-67) which featured this nugget of etiquette: '[H]ow to raise water constantly… This I confess I have seen and learned…; and I desire not to own any other Men's inventions, but if I let down any, to nominate likewise the Inventor.'[225] In the same year the Marquis also received the benefit of a Private Act: *An Exact and True Definition of the most stupendous Water-Commanding Engine*.[226] The justification reflected the earlier Acontius-type justifications and the 'particulars' consisted of eight bland statements which, coupled with the realisation that the grant was for ninety-nine years in consideration for a ten percent appropriation for the king's Majesty, implied it would be difficult to conceive of a more odious monopoly. Some such, whether for pecuniary or policy reasons, were still permitted to stand post Restoration. Behind this bare catalogue there *was* a persistent experimenter but also one who liked to employ engraved ciphers for brevity of writing if not secrecy, yet here the Marquis was also progressing prior art, previously divulged through (i) a crude *quarto* wood-engraving[227] and (ii) simple woodcut figures in an otherwise elaborate folio work.[228] Within the Act there was a requirement to lodge a model in the Exchequer. An attempt to recreate this engine was later reported with the results

[222] 21 Jac. I c. 3. Section XIV. Dudley's secrets were to die with him.
[223] Dudley, p. 63.
[224] The use of coal in iron smelting was delayed until 1738 (see Darby, Chapter 3, who restricted the 'process' to his son and grandson).
[225] Worcester, Edward Somerset, Marquis of: *A Century of the Names and Scantlings of such Inventions…,* London: J. Grismond, 1663, pp. 46-47 (from 1746 reprint by T. Payne). No. 68.
[226] 15 Car. II. c. 12 (1663).
[227] Porta, J. B. *I tre Libri de' Spiritalia*, Naples: 1606.
[228] de Caus, S. *Les Raisons des forces Mouvantes avec diverses Machines*, Francfort: 1615, p. 4.

concluding that it was 'practically impossible to produce an apparatus fulfilling *all* the conditions of the description…without introducing parts…due to the inventive genius of other mechanics…'[229]

There was however a grant which was altogether more demanding on the applicant of the era. This emanated from across the North Sea. For, in exchange for his detailed description, William Wheler received a patent for a water-scoop from the United Netherlands, a location with a particular interest in exploiting water mills for drainage purposes.[230] In any language this 1639 privilege, initially for twelve years though later extended, represented a new departure and whether intentional or otherwise was much more aligned with the disclosure elements of Sturtevant's treatise than anything to this point. While the description of the device(s) undoubtedly relies heavily on geometric principles and hence laws of nature, its eligibility for the award of a patent for invention as would likely be challenged today, is less important to this thesis than the conceptual formatting of information imparted in the applicant's '*Description, & c.*' in support of the Octroy.[231] For the geometric dimensions were supported by Figures, the combination of which amalgamated the 'plan and the perspective view'. Through its published fusion of a composite of written description, graphics and geometry now being crystallised and advanced, the earlier approaches of Bourne, Dee and Gunter in providing a viable template for schema of instruction increasingly attached to subsequent grants.

More specifically, validation was provided through a comparison with already extant common-place water-raising wheels. Most informatively the wheel is described from '*within*' as are the '*form*' of the water and the centre of gravity. An extract of the latter reads:

> '[*F*]*or greater facility and sufficient correctness…the section E, G, is known to be 1/6 of a circle whose diameter is 26 feet; this gives 13½ feet …and there being 11 degrees between the diameter A, C, and the line K, I,*

[229] Mechanics' Magazine, 59, 9 Oct. 1824, p. 37.
[230] Exclusive privilege granted at the Assembly (High States General) The Hague, 18 June 1639.
[231] *Description of the Nature & Working of the Patent Water-Scoop Wheels, invented by William Wheler, as compared with the Raising-Wheels now in Common Use*. By J.B.W. Translated from the Dutch for the Commissioners of Patents by Dr. A. Tolhausen, Amsterdam: John Blaen, 1645 (from pp. 75-92 of 1858 reprint by G. E. Eyre & W. Spottinwoode).

it follows that the point where the raising power is to bear on, is situated little less than 2½ feet from the centre….[232].

In terms of exactitude this grant represented a quantum leap in terms of the detail divulged. That this had been so recognised by the Dutch authorities might also be implied by an extract attached to the last leaf (after several extensions to the term). This, in an intriguing coalescence of a patent for invention with printing privileges, read…

'*allows the said partners to sell the present treatise: and cause it to be sold by John Wybrantsz Colck…forbidding all others… to have it printed or to import it into these Provinces, and sell it without the consent of the said partners, under the penalty of forfeiting the counterfeit copies, and paying a fine of 300 florins…* '[233]

These inventions were later to be the subject of an English Patent of 24 June, 1642 (the sole patent of that year).[234] Like contemporaneous patents Woodcroft noted the absence of a description other than the Dutch treatise by 'JBW'.

The emergent correlation between the written description and scientific advance has been expounded in this section. Also shown has been the unfortunate misunderstanding of the role of Sturtevant which indeed started barely after his patent had been granted. Even the admonishment that his credentials were lost in a cloak of veiled discourse, are incompatible with his call for the use of '*moddles*' and also his advocacy for:

'*a plaine and familiar discription,… by…writings or by printed treatises.* '[235]

Such strides, facilitated as they were by the new medium of the printed book, were not always convenient for the preservation of the monarch's prerogative and in this case were supplanted after an improbably short time.

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[232] Wheler., p. 81.
[233] Wheler, p. 92.
[234] GB 127 [1642]. Woodcroft's *Appendix* (see Cumulative Resources at rear of this thesis) while not disclosing a specification, included the subject matter as 'raising water; auger for boring wood; fixing piles without driving; raising weights'; does specify quantitative, measurable claims as outputs. Sir William Wheeler was born in Holland only taking letters of denization in 1639. http://www.historyofparliamentonline.org/volume/1660-1690/member/wheeler-sir-william-1601-66 Accessed: 24 October 2016.
[235] Sturtevant, pp. 64, 75-76.

2.6 The catalytic imperative for judicature of Edward Darcy and Thomas Allin

The Case of Monopolies continues to allow the Commons to encroach upon the prerogative.

2.6.1 A house of cards, Coke's perspective and a shaky foundation

Appearing for the plaintiff in *Darcy v Allin* was Edward Coke. A later Speaker of the House of Commons, Attorney-General and Lord Chief Justice, he introduced an unsuccessful[236] monopolies bill in 1621 the footprint of which remained, not least as James first prorogued and then instigated his fourth and last Parliament in 1624.

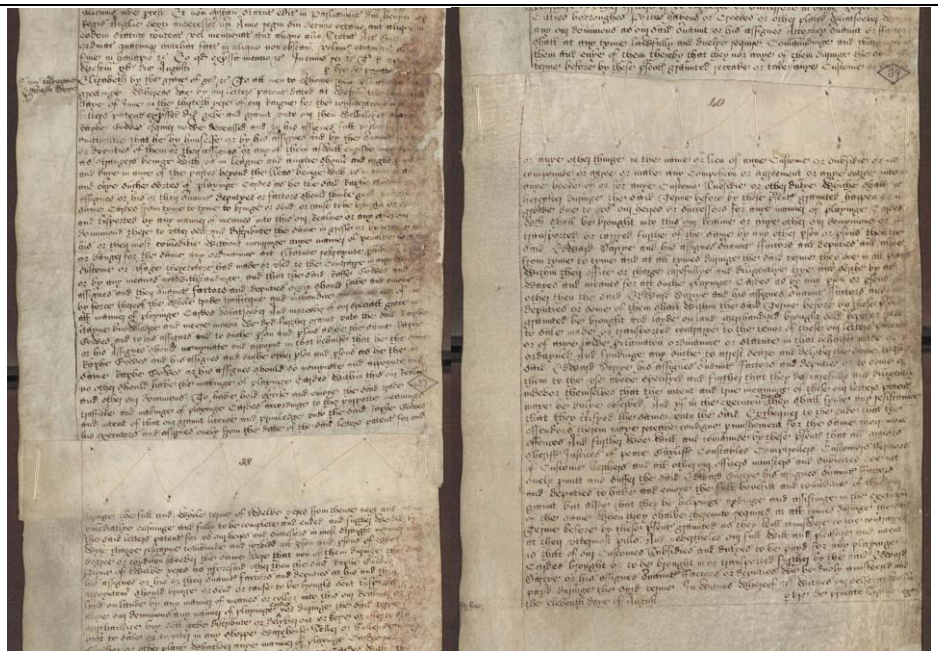

Figure 2.6

Letters Patent awarded to Edward Darcy, 11 August 1598

(Photographed from original roll C66-1485, mm. 38-40 held at TNA)

[236] Approved by the Commons but rejected by the Lords on 1 December, for as described in the Journal of the House (Vol. 3) two days later, it 'was not fit to be presented…, for it seems to restrain His Majesty's Prerogative from Grants and Dispensations in the future.' That there was sympathy for the measure is confirmed by an immediate mention of arrangements for a replacement. A week later provisos for excepting: 'Things newly invented' 'Corporations' and the 'Privilege of Printing' (to be left to the King as entire as before the Act) appeared in the Heads.

The defendant's defiance of the playing card monopoly (Figure 2.6) was supported by the Mayor and Aldermen of London, presumably seeking to defend traditional guild privileges.[237] In a manner indicative of the importance of the proceedings to these allies, is found:

> *'Now Mr. Darcy…would discourage men to labour to be skilful in any art, and bring in barbarism and confusion.'*[238]

Given the high stakes, it is unsurprising that the case traversed two terms and that the justices did not immediately deliver their reasons for voiding the patent.[239] Boehm also considered the 'failure' of Chief Justice Popham to 'discuss patents' (of invention) in this case,[240] but although there is much supporting material evincing the evils of the monopoly patent, this consideration must be in error as, towards the end of the judgment, one finds:

> *'…Judges have heretofore allowed…where any man,…by his own wit or invention doth bring …any engine tending to the furtherance of a trade that never was used before…: that in such cases the King may grant to him a monopoly patent for some reasonable time, until the subjects may learn the same….'*[241]

Corré has provided an analysis of some disconnection between Coke's recordings on the case which seemed to attempt to provide some retrospective comfort to his later position on monopolies.[242] As Fisher has described, from such personal distaste of monopolies (now experienced at first hand) Coke, rather than viewing this instrument as 'an anodyne vehicle for governance that could be abused like practically any other exclusive right,…he clearly viewed it as a monster to be tamed.'[243] For this thesis however, one salient point that emerged from the arguments comes from the observation by one of the three defence lawyers John Dodderidge: '…if it is alleged that the defendant was *satis sciens* (knowing well

[237] Corré, J. I. The Argument, Decision, and Reports of *Darcy v Allen*, *Emory Law Journal*, 45, 1996, pp. 1261-1327 at 1263.
[238] *Darcy* v *Allin*, at Noy, 179.
[239] Corré, p. 1267.
[240] Boehm, pp. 15-16.
[241] *Darcy* v *Allin*, at Noy 182. Immediately after this section there follows (182-83) several examples of invalid patents due to the existence of prior art possibly unknown to the applicants. A written specification would presumably have helped prevent some of the resulting discord.
[242] Corré, p. 1280.
[243] Fisher, M. The Case that Launched a Thousand Writs, or All that is dross? Re-conceiving Darcy v Allen: The Case of Monopolies, *Intellectual Property Quarterly*, 4, 2010, pp. 356-72 at 365.

enough) it would be sufficient in a declaration. But that is where the notice is not traversable, but the defendant is bound to take notice at his peril'.[244] The 'defence' goes on to define three means by which such notice could be given: by writ, by proclamation or by showing the patent; before declaring, that while Allin '*had heard it said'* that Darcy possessed such a privilege, in the absence of the aforementioned formal written media, the defendant could not be said to have been *satis sciens*, and while Corré suggests the point is not well made, Dodderidge may have identified a fatal position for the plaintiff.[245]

In an oblique validation of the central theme of this thesis, Coke in a description of how the possessor of such a cartel might hinder the 'publick weale' was to later liken '*the monopolist to the concealer whose claims and titles are "mere illusions"'.*[246] This point was clear in the mirror of hindsight. Yet the Commons had been grappling with this phase of manipulative monopoly and its inextricable link with the prerogative since 1571 this being just over a decade since the grant to Acontius for his invention. The wisdom of isolating a patent for invention seem obvious today, yet the method of approach (whether to proceed by petition or by bill) was anything but tangential to the members by 1601. In response to the introduction of a bill entitled 'An Act of Explanation of the Common-Law, in certain Cases of Letters-Patents' Francis Bacon noted the merit of one who might 'bring any new invention, which every subject of this realm may use' after a 'certain time' without specifying how details of the advance were then to be conveyed and he argued against the prospect of a prerogative-denying bill with its approach of making exceptions in favour of corporations.[247] While also defensive of the prerogative, Cecil too now urged discrimination between good and bad patents. Discord was by now so amplified however that the queen, in one of her last public acts intervened (the Golden Speech above). Certainly the notion that an adequate description of a patent, not least a patent for invention, should be a discriminating, if not quite essential component of a grant from this point on certainly emerges. This position was probably lost in the ongoing focus on the status of the prerogative.

[244] Corré, p. 1292.
[245] *Ibid.*, p. 1293.
[246] Fisher, M. p. 366.
[247] By MP Lawrence Hide. Townsend, H. *Historical Collections: Or, An Exact Account of the Proceedings of the last four Parliaments of Queen Elizabeth*, London: Basset, Crooke & Cademan, 1680, pp. 231-32.

2.7 Some unanticipated consequences of the monopolist in the Star Chamber

2.7.1 Conflict between Courts of Law and Courts of Equity

2.7.1.1 Making models: the connection with monopoly patents

Matters came to a head between champions of the royal prerogative and the perceived rigid and insufficient Lord Chief Justice in 1616, when relief against certain common law judgments were delivered by the Court of Chancery.[248] Sensing a potential threat to his prerogative, the king had been advocating (see his promotion of technical indexes in Section 3.2.1.5) that the law be written 'in our vulgar language' rather than 'an old, mixt and corrupt Language, onely understood by Lawyers.'[249] With the scientific awakening barely rooted we can scarcely be surprised at the absence thus far of adequate patent specifications when the law was itself, so replete with this vertigo of contradictions.

Advice for this 1616 decision had been secured from Sir Francis Bacon, with Egerton and Bacon (the Attorney General, future Lord Keeper, and Lord Chancellor) subsequently collaborating for the dismissal of Coke, concerning the latter's failure to consult with the monarch in relation to judgments being handed down in which the king had an interest.[250] One such example contained an early promise of description should a model not be forthcoming.[251] Seaborne Davies, in discussing the importance of this and a handful of similar grants (contemporaneous with Sturtevant's) noted however the open-ended nature of the privileges, with their requirement that additional developments be adjudicated upon through the submission of models; in reality, most likely drawings.[252]

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[248] *Heath v Rydley* 11 JAC. 1. Cro Jac 335 and *Courtney v Granvil* 12 JAC. 1. Cro Jac 344.
[249] McIlwain, C. H. (ed.) *The Political Works of James 1*, Cambridge, Mass.: Harvard University Press, 1918, p. 311 (21 March 1609 Speech to Parliament).
[250] Coke, Sir E. '*Vade Mecum*' 14 November, 1616 in: *Collectanea Topographica & Genealogica*, Vol. VI, London: Soc. Of Antiquaries, 1840, pp. 108-22 at 119.
[251] Highlighting the role of the Lord Chancellor, the recitals of John Usher's patent of 1612 included: '*of which Engine Instruments or new Invention they have undertaken within one month after the date of our Letters Patent to deliver to our Chancellor of England a perfect model or description to remain and be disposed as our said Chancellor shall think fit*.' Patent Rolls, 10 Jac. I, pt. 7.
[252] Seaborne Davies (III, 1934) pp. 268-71.

2.7.1.2 Coke's *coup-de-grâce?*

The king meanwhile continued to grant monopolies and the prerogative courts continued to enforce them.[253] Nemesis had been delayed [254] but was now inevitable. On February 5, a few days into the 1620-21 Parliament, Coke, now a member of the House, moved for a Committee on Grievances. Almost immediately the Royalist position capitulated with among the most significant casualties, the referees of obnoxious monopolies, including those patents for licensing inns (Sir Giles Mompesson) and alehouses (Sir Francis Mitchell) but more significantly for this thesis, a patent claiming the manufacture of gold and silver thread had first been awarded in 1611, re-sealed in 1616 and surrendered in 1618.[255] The original had proceeded:

> *'…[R]ichard Dike…do undertake to establish and perfecte…Venice gold and silver threed…hath been made, beaten, cutt, threaded, and spunne in… Italie and France…have already att their charge sett upp…divers frames, loomes, ingines…and doe likewise intende to teach…instructe…and employ… our people in the said arte, misterie, trade, or feate …a trade not heretofore used.'.*[256]

This preamble informs us of the continuation of the policy of enticement of foreign expertise, and is more forthright on promulgation of technique yet here at the dawn of the Statute of Monopolies, maintained an unspecified provision as to how this might happen. Despite the virtuous sentiments, the reality was that a proper description remained absent and a parallel monopoly patent (Mompesson's) was being policed with extraordinary powers of search and arrest, being so protected by the deferential Bacon.[257] Once Coke's Committee (devoid of those with an interest in patents) was established, with power of investigation into the veracity of the suggested privileges, the Crown in essence at first admitted defeat and the patent holders of this and some other monopolies were surrendered with others revoked.

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[253] Boehm, pp. 15-16 noted this role for the Council and Star Chamber.
[254] Being Scottish James did not have a natural constituency at Court when Elizabeth died and presided over few traditional loyalties. It is not a surprise that he pursued policies of favouritism.
[255] Fox, pp. 107-09, 159-89.
[256] Patent Roll, 9 Jac. I. pt. 7. 5 June, 1611. A further patent was issued in 1620.
[257] Fox, p. 105.

A standout occurrence was that on May 16, 1621, when a committee was established so as to '*reduce into writing details of the patents already damned'*[258] this being a forerunner to a promise by Coke that he would prevail upon the king to recall any offending grants. The formality may simply be good housekeeping, though this note resonates somewhat and is worth questioning given that the Commons had been recording its deliberations in journal form anyway since at least 1547. Furthermore, the size of the committee (24 Members) and the calibre of the members (Coke, Sandys, Noye, and Wentworth to select a few) hints that this may not have been a mere clerical exercise. The terms of reference were also concluded with an undertaking to similarly treat patents '*hereafter to be damned'* so presumably the members were about to assess factual traits of each. Also by now the Commons had moved its focus somewhat to also include, under the monopoly umbrella, export-import cartels and an assumed metropolitan plot against the provinces, allegedly sponsored by national chartered companies.[259] The rot had set in under Elizabeth with, in the words of Hulme, for grants with a *non obstante* clause 'the delegation…of the dispensing power to an individual was a monstrous development of the constitutional theory.'[260] It is not a surprise therefore to see sentiments and recordings of this nature given the next development (below) 'under the colour of a redress of grievances…'[261] This is the first explicit acknowledgment that a written description was an edifice less likely to be monopolised but as the technical narratives of inventions were not the subject matter, the concept remained immature and imprecise and had not fully established.

Sample contemporary patents such as that to Crumpe (1618)[262] and Middleton (1621) contained but rudiments of specification.[263] Indeed the copy of Crumpe's patent seems to acknowledge the stultifying deficiencies of the prevailing system where, prior to allowing a continuation of extant machines and methods, is found:

> '*notwithstanding the not particular or not exact describing of the said way or invention of making…or using of the said engines…and notwithstanding*

[258] Sir Tho. Wentworth from: House of Commons Journal, I Ed. VI to 4 Ch. I (1547-1628) Vol. I, p. 622.
[259] Ashton, R. *The City and the Court 1603-1643*, Cambridge: University Press, 1979, p. 108.
[260] Hulme (1900) p. 54.
[261] *Ibid.*
[262] GB 8 [1618] Pumps for Draining Mines, Raising Water for the Service of Towns, Castles, &c.
[263] GB 19 [1621] Draining Grounds. See also conclusion to this chapter.

the not particular description of the instrument, tooles, engines, or devices to be used..'[264]

Valid inventions needed to have more informed succour and protection whereas society needed a vastly more effective register of information handover than this.

The Committee found that the king had been misinformed in relation to the Mompesson grant, a finding of such import that this principal holder was banished and Bacon's disgrace confirmed by his being '*relieved of the Great Seal'*.[265] Egerton as Lord Chancellor was unable to restrain the momentum for change, and now, the Commons seized the initiative; James (and the Lords) would have to accept the inevitability personified in the Statute of Monopolies which relied heavily on the principles espoused in the king's own *Book of Bounty*.

The Statute of Monopolies of 1624 exempted (in Section 6) patents of invention, this allowance being the really relevant aspect; the separation of the capability of being able to obtain a patent for invention that was not a monopoly. This exception is contained in the following terms:

'...[*B*]e *declared and enacted that any declaration before mencioned shall not extend to any letters patents and graunts of privilege for the tearme of fowerteen yeares or under, hereafter to be made of the sole working or making of any manner of new manufactures within this Realme, to the true and first inventor and inventors of such manufactures;'*[266]

As per Darcy, henceforth all monopoly cases would be heard at common law. Furthermore of course, the scientific revolution had yet to emerge (Chapter 3).

2.7.1.3 The guilds aren't going quietly

The double apprenticeship term of fourteen years, presumably incorporated to entice foreign artisans by denying local journeymen the opportunity to compete, was now established, but to what ends other than a time limit? One reflection connecting the treatment of the guilds in this thesis to the stipulated period can be found later in the Statute:

[264] Lines 22-26.
[265] Fox, p. 110.
[266] 21 Jac. I c. 3. Section VI.

> '*this Act …shall not in any wyse…be prejudiciall unto the city of London… any art trade occupacion or mistery,…or merchants within this Realme, …, but that the same…and their…, priviledges…continue of such force and effect as they were before…* '[267]

There is a distinct sense of *status quo* and the enmeshment of even guilds but especially now the merchants, throughout English society. Ironically, such entities were particularly adept at exploiting that new mouthpiece of communication; the printed petition to parliament. These had literally saturated both chambers from 1621 to the extent that the Lords instructed the Stationers to desist from their printing in April 1624.[268] The episode however further highlights the role of print in accessing the levers of change.

Yet, an additional perspective might be that monopolies were originally the vehicle through which commercial change, top-down, was foisted on an economy in thrall to the accepted jurisdiction of guilds whose self-preservation depended on marked-out exclusionary prowess. Indeed, the original 1621 Bill *An Act concerning Monopolies, and Dispensations with penal Laws, and the Forfeitures thereof* sent up from the Commons had been thrown out by the Lords as potentially restraining the prerogative and on the format of which they sought negotiations with the Commons over exceptions.[269] The Bill may not have contained that *eventual* Section (IX) of the Statute offering comfort to the guilds with Coke even suggesting: '[T]his an excellent Bill.-Wisheth some of the Eight Provisoes had been out.'[270] Nachbar extrapolates that a mirrored sequence occurred for the subsequent Statute in that 'the content of the Lords' objections suggests that as originally sent up from the Commons, the Statute ended at Section 8.'[271] The same author has suggested that Coke, while undoubtedly keen to get the Statute over the line, did not deem this Section necessary or worthy, as guild control could not be associated with 'incidents of monopoly at all.'[272] The perspective that there was any relationship between attempts to sustain a buttress of technical information and

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[267] 21 Jac. I c. 3. Section IX.
[268] Jackson, W. A. (ed.) *Records of the Court of the Stationers' Company, 1602-1640*, London: Bibliographical Society, 1957, p. 166.
In this decade the first printed newssheets also appeared.
[269] House of Lords Journal, op. cit., (3 Dec 1621) Vol. 3 pp. 178-80.
[270] House of Commons Journal, op. cit., (12 May 1621) Vol. I, p. 619.
[271] Nachbar, T. B. Monopoly, Mercantilism, and the Politics of Regulation, *Virginia Law Review*, 91, 6, 2005, pp. 1313-79 at 1350.
[272] *Ibid.*, 1349-50.

monopoly had not gelled. Rather the proviso concerning new inventions remained subordinate to the parliamentary wish to extend the formalism of common law courts to restrict the monarch-dominated prerogative courts.[273] Such a prescription would inevitably, yet much later, manifest downstream in the convention of the written description.

2.7.1.4 The Midas touch

Here lies the real legacy of Mompesson being thrown to the wolves.[274] While several monopolies survived the tumult, among those that were cancelled were the patents for gold and silver thread, the patent for inns, and the patent for concealed lands.[275] A supreme irony was the incorporation (relying on Section IX) of the Company of Makers of Playing Cards in 1628 creating a valuable monopoly and a source of revenue through taxation, after abolition of a patent for importation of cards[276] following protests by the Company of Merchants Trading with France.[277]

James had protested that parliament was not the venue for adjudicating on validity (patents rarely found their way into the courts during this period of parliamentary oversight) 'and condemned them upon so short examination. I confess I might have passed some upon false suggestion and wrong information.'[278] The sense remains then that the Statute, despite its later manifestations of protecting inventions, may have been urged by a restive parliament, but from the king's perspective was primarily conceived to buy time, such that the Crown might alter its fiduciary base so as to discount patents of registration (inns and ale-houses) in return for new mechanisms to extract anticipated revenues from foreign trade. The last thing a Privy Council needed at this remove was a measure to forestall access to these new targets. Such an

[273] Nard, C. A. Morriss, A. P. Constitutionalizing Patents: From Venice to Philadelphia, *Case Western Reserve University Case Research Paper Series in Legal Studies*, Paper 587, 2006, pp. 222-320 at 289.
[274] House of Lords Journal, 27 March 1621 Vol. III, pp. 72-74.
[275] In relation to Mompesson's role, the debates on these are reported extensively in Notestein. See, for the interests noted above and held by him, for example: Volume 5, pp. 278-82.
[276] Tosney, N. The Playing Card Trade in Modern England, *Historical Research*, 84, 226, 2011, pp. 637-656 at 640, 655.
[277] Atkinson, E. G. (ed.) *Acts of the Privy Council of England*, 1615-16, London: HMSO, 1925, Vol. 34 (12 Nov. 1615) pp. 324-25.
[278] Cobbett's Parliamentary History of England Vol. 1 (Comprising the Period from the Conquest in 1066, to the Death of King James the First in the year 1625). London: Bagshaw, 1806, p 1503.

impediment would have anchored had there been any demand for a 'sole actor' to provide a written description attached to a pleading for a patent grant. Consequently, the latent, accrued benefit from an entire industry may have similarly been put at risk had an identikit approach been stipulated from the convenors of monopolies attached to salt, soap and iron. Returning to playing cards, Tosney has noted the virtual absence of descriptions of how they were produced on an industrial scale during this century.[279] Further commentary has suggested such promotion of local, luxury industries be attributed to import substitution[280] as a means of sustaining monopoly.[281] As such there would be no need for the complications accompanying a written description.

There remains no sense of the legislation making any contribution to the orderly advance of technical matters underwritten by the provision of a transfer of the written fruits of technical knowledge. But of course this was not its intention. In theory at least, although this was to be several decades more playing out, henceforth, the shadow of monopoly would not shroud so many of the nation's everyday activities. Also untouchable, in a sense doffing the cap to the power of the new medium of communication was to be the grants of privilege 'heretofore made or hereafter to be made of for or concerning printing… '[282]

The footprint of language can take a long time to erode. In this thesis it has been demonstrated that it also takes a protracted time to find purchase.[283] The obligation to supply an adequate description was only stipulated in the 1852 Act.[284] Yet while the Statute endured a particularly long time, indirectly the Industrial Revolution wore it down, its recalibration personified eventually by the 1835 enactment which was to be the first public Act to deal with patents since the 1624 Statute.[285]

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[279] Tosney, N. p. 638.
[280] Peck, L. L. Luxury and War: Reconsidering Luxury Consumption in 17th Century England, *Albion*, xxxiv, 2002, pp. 1-23 at 3-4.
[281] Ormrod, D. *The Rise of Commercial Empires: England and the Netherlands in the Age of Mercantilism, 1650-1770*, Cambridge: University Press, 2002, p. 143.
[282] 21 Jac. I c. 3. Section X.
[283] One unintended consequence for this term is that it was much later to have a profound bearing on future legal aspects of the development of the exclusion of methods of medical treatment from patentability. Using the language of the *Statute of Monopolies*, nations apply exceptions to patentability such as the TRIPs medical treatment exception, in different ways.
Vaver, D. Invention in Patent Law: A Review and a Modest Proposal. *International Journal of Law and Information Technology*, 2, 3, 2003, pp. 286-307.
[284] See also Chapter 3.
[285] An Act to Amend the Law touching Letters Patent for Inventions 5 & 6 Wm. IV c. 83.

2.8 Conclusion

Associated with the arrival of printed instruction there was a diverse, multi-strata emancipation of society and the mind-sets of its inhabitants. Quickest to adapt, mathematics and the more value-added craft of surgery were at the forefront of establishing new elements of technical communication. Diffusion of such altered perspectives would become increasingly incompatible with the prerogative of monarchs. The abuses of corrupt monopolies and the attendant parliamentarian responses cleared the way and there was established a legal basis for the security of inventions, an essential prerequisite for technological advancement. The path was now paved for the later requirement for the written description of the patent specification yet there were still few travellers; discouraged presumably by the absence of an appropriate map. A grant to Hugh Middleton in 1621 had contained the justification that the grantee 'hath offered to publish and practise his skill amongst our loving subjects…' but any enabling mechanism was absent.[286] Notwithstanding a sixty-five year wait until Parliament wrestled control of the State finances from the Crown in 1689 and the subsequent elimination of the granting of objectionable monopolies, after many setbacks, Coke the champion of common law, had prevailed and this legislative *nous* represented by the Statute of Monopolies was to remain for over two hundred years. While it represents a convenient option for pause, in the face of incessant technological change, some have questioned its absolute significance.[287]

[286] GB 19 [1621].
[287] It has been contended that the *Statute of Monopolies* played, at best, a minimal role and that the real basis for patent law lay in the Royal Charters and Royal Letters Patent of the Crown. Sherman, B. Bently, L. (1999) p.209.

Chapter 3

Communities of Enquiry Record Their Experiments

At Gresham College a learned knot
Unparalleled designs have layed
To make themselves a corporation
And know all things by demonstration.

These are not men of common mould,
They covet fame but condemn gold.

William & Joseph Glanvill
Dorothy Stimson's *Scientists and Amateurs: A history of the Royal Society*, London: Sigma Books, 1949, p. 57.

3. Communities of enquiry record their experiments

3.1 Introduction

In the decades after the passage of the Statute of Monopolies England's entrepreneurial capacity needed to emerge from the sequential constraints imposed by feudal imbalances, capricious government and constitutional instability. Nevertheless, ambitious innovators proliferated as coal was to become the central technological stimulus of an increasingly urbanised age. Yet many had to negotiate a hostile environment, where, borne as propaganda, the printed word had given birth to an atmosphere of trepidation for one's beliefs and liberties, with cycles of antipapist animus and civil war all-pervasive. Ironically, if the eldest child of this tumult was the birth of the scientific method, the favoured offspring was its application to the advance of more practical pursuits.

Despite the obstacles, elements that were progressive sought to prosper; undoubtedly however, a well-heeled and favourably-positioned cohort were frequently dedicated to private, not national ends. Interwoven through this progressively colonial-driven society, the socio-economic fabric of the period drove the range of problems investigated by early scientists. These erudite practitioners aligned their roles with academies and scientific societies in piloting new approaches to knowledge. This coalescence stimulated a higher level of technical cohesion, 'graduates' availing of the opportunities afforded not by the written records of private correspondences but to emerging modes of communication; abetted by the experimentalist's demonstration in the laboratory[1] and soon thereafter, the discipline-specific printed periodical.

One emerging profession uniquely located at this interface was pharmacy. Printing would have a profound influence on the study of plant-based drugs. Drawing down the legacy of the marriage of illustration with written description (Chapter 2) unambiguous renditions of pharmacologically-relevant botanicals were now possible. This was a stimulus to new research especially when standardised publication of collections describing properties (pharmacopoeia) themselves expanded to include manipulations from chemistry, that new tool of the bench practitioner.

[1] Black, A. The Orator in the Laboratory: Rhetoric and Experimentation in Thomas Shadwell's The Virtuoso, *Restoration: Studies in English Literary Culture, 1660-1700*, 37, 1, 2013, pp. 3-17.

Yet publications needed to rapidly narrow their focus as the natural sciences split into specialism, a reduction ironically once familiar to erstwhile guild-based practitioners, but of course the rate and extent of communication was now realised of an exponential intensity never before seen. A crucial dividend inspired by this accumulated ingenuity was that path laid to an increasingly conversant judiciary just as they began to formalise *their* demands for appropriate specification in the construction of patents.

This chapter continues the effort to reveal the maturing intellectual linkages, which still remained significantly indebted to and sometimes under the tutelage of the medically educated, but this time incorporating chemical, naval and industrial innovation. The result was a transformation of society through the patronage of the scientific method and the analysis determines how this was communicated, ultimately *via* the patent specification, thereby accelerating the adaptation of innovation and industrialisation. The analysis ceases *circa* 1800; after this juncture a ready supply of coal and money-making ambitions invoked a plateau in enthusiasm for industrial design and the spreading of innovations as mass production dominated; paradoxically a position that underlined the necessity of patent authorities needing the discriminating powers of a specification's convincing description. The patent agent could now step in.

3.2 Clarity of analysis

3.2.1 Experimentalists invent the scientific method

3.2.1.1 The abode and the experiment done

In one unintended consequence of the English Reformation, methodologies underpinned and delivered by experimentation saw a relocation of natural philosophy from the monasteries. With the universities being few in number and routinely resistant to the disruptive authority of the scientific method, early advocates saw fit to practice in the home.[2] Given this domestic arrangement, many of these textual outputs were, of necessity, in manuscript format. This was multiply problematic. Firstly, even the most diligent practitioner must have struggled with recording arrangements and with attempts to separate the trivial from the profound: and this before endeavours to preserve any new knowledge. In order to secure the extendibility and fidelity of memory in the face of empirical details of increasingly minute exactitude, new recording and more crucially, reporting formats, were required to sate the curiosities of emerging networks of the knowledgeable.

One compiler[3] evolved an efficiency of cross-referencing where he schemed 'connections between themes, substances and experiments on the existing manuscripts' pages'[4] with multiplets of information occasioning a cancellation of the text in the primary location. Of a higher plane than Bourne's arrangements, the resultant chronological, yet necessarily restrictive, organisation could not satisfactorily sustain in the face of increasingly complex, often international pursuits.

[2] Harkness, D. E. Managing an Experimental Household: The Dees of Mortlake and the Practice of Natural Philosophy, *Isis*, 88, 2, 1997, pp. 247-62.
[3] A physician (probably from Cambridge, writing towards the end of the sixteenth century, and with the initials C.S.) he recorded alchemical materials, including *pharmaceutica* and *medica*, in the portable manner of early English surgeon-chronicler John of Arderne.
[4] Timmermann, A. Alchemical Verse and the Organisation of Knowledge, Verse and Transmutation, Brill Open E-Book Collection, 2013, pp. 173-202 at 175, 179.

3.2.1.2 Gilbert points the way

Continuing the correlations noted earlier, the cornerstone for some of the following communities described in this chapter was also a gifted sole practitioner; this time the physician of Queen Elizabeth. The hue of the achievements of William Gilbert (1540-1603) shines a particularly bright ray in ushering a new era of scientific pursuit[5] for, in the year of his appointment (1600) as the monarch's personal doctor, he had published the first significant work in the physical sciences in England.[6] While ground-breaking for its knowledge of magnetism, the compass, in distinguishing magnetic mass from weight and its introduction of the concept of electricity, *De Magnete*'s immediate contribution was in solving practical problems for navigation and astronomy. However, what especially singled it out retrospectively was its manner of exposing measurement to rigorous scientific reasoning, such that Galileo (1564-1642) subsequently described Gilbert as the founder of the experimental method of science.[7]

The essence of this forerunner empiricist could be summarised as: he did not rely on authority; for him words alone were inadequate, for example he derided alchemists for their opacity of language (Gilbert had a particular interest in medical applications of iron). He jettisoned the mused writings of Scholastics and contemporary philosophers; all were laundered through his process of strident investigation of new phenomena, an appraisal where he based the entirety of his findings on experience. This was the application of *his* new philosophy whereby one could 'look for knowledge not in books only but in things themselves.'[8] Perhaps subconsciously, in a denial of the historical prejudice against manual arts, this challenge to doctrine reflected the applied chronicling of Ramus (Chapter 2). An additional coincidence was the recent establishment of what has been coined 'public education'. For a contemporary text had decried the attempts of classical education at hoarding the liberal arts.[9] Increasingly the denial of social imbalance demanded that each stratum be liberated from its legacy of prejudice.

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[5] See also 2.4.1.3 for his role in championing peer review.
[6] Gilbert, W. *De Magnete Magneticisque Corporibus, et de Magno Magnete Tellure* (Concerning Magnetism, Magnetic Bodies, and the Great Magnet Earth, London: 1600.
[7] Gribbin, pp. 68-72. Gilbert also influenced Kepler and Newton.
[8] *De Magnete* (preface).
[9] Fenner, D. *The Artes of Logike and Rhethorike*, Middleburg (Netherlands): R. Schilders, 1584.

Yet Gilbert also needs to be held to account: for while understandably focused on the use of the mariner's compass and the observed quantities therein, notably unforgivable was his failure to accord to Robert Norman sufficient credit, both as the instrument-maker and his role as template-holder, for a published exposition, with hypothesis, on magnetic experimental method in the manner of inductive scientific pursuit.[10]

A valuable synergy was fortuitously unfolding however. Into the breech had entered the trustees of London's Gresham College[11] who, in their statutes of 1596 stipulated that lectures be delivered in the vernacular, an eminently sensible strategy for an institution devoted to vocational advantage. The further colonisation of human intellect as personified in new technical communications and publications was immaculately timed, a seasoned crop of increasingly skilled technical practitioners were eager to avail of London's entrepreneurial atmosphere and sponsorship opportunities.

In any event, Gilbert's championing of scientific method was no longer anticipated or the preserve of the classically educated but underway and now with its own future history. This new approach first required a conjecture, followed by the fabrication and deployment of apparatus to interrogate the hypothesis, and culminated in the recording and assessment of observations from the cross-examination of the proposition. This was a new dynamic, one that demanded witness from anybody present or later explication from the writing down of the elements of the metes and bounds of what premise had been challenged.

3.2.1.3 Additional Italian imports

Independently of Gilbert's thesis, by 1600 there had also been a smattering of gatherings of natural scientists (principally Italian) where new information might be readily exchanged. The ongoing torpor within higher education was exemplified through the observation that with the exception of Padova (through its innovatory delivery of the combined practical and increasingly academic fortes of surgery, Chapter 2) these assemblies tended to be independent of the universities. An

[10] Norman, R. *The Newe Attractive*, London: 1581.
[11] See later. Carlson, E. Public Learning and Private Learners: The Separation of Public and Private in Renaissance Literature and Pedagogy, *History Compass*, 10, 9, 2012, pp. 644-51 at 647.

additional merit in such meetings was that expensive equipment might be shared and readily accessed. One, the Roman *Academia dei Lincei*[12] commenced publication in 1609 of the *Gesta Lynceorum*, the first accounts of research by members of a learned society to be printed. The fashion thus started, like other influences noted earlier in this thesis, was later copied abroad, becoming the most profound vehicle for rapid dissemination of new knowledge. Its local tenure was short lived however as its most famous member, Galileo, was persecuted and it was obliged to drop physics. Despite the short-sightedness, this conversion of scientific enquiry from the clumsy probing of individual eccentricity into a 'socially organised pursuit' was a seminal moment.[13] Yet ironically while additional centres were founded in Florence and featured Galileo's leading disciple (Evangelista Torricelli 1608-47, the prompter of the steam vacuum, examined later) Italian scientific hegemony was about to be displaced and transferred to France and England. It also suffered from the burden of suffocation, becoming fenced in by a secrecy-obsessed patronage of city-state autocrats,[14] a handicap unlikely to be applied further to the North.

3.2.1.4 Compiling for the elixirs of life

There is a sense of unfulfilled experiment about alchemical activities, for example the groundbreaking, earliest Italian text[15] possessed wide margins allowing subsequent annotation (paper was expensive anyway). By now however printing was transformative; the notion of the book as a luxury item was in decline. One author, if not the genre's mastermind, was Paracelsus, a careful recorder of experimental procedure (Table 2.1). He was also the instigator of the thesis that: '[T]he true use of chemistry is not to make gold but to prepare medicines.' His iatrochemical efforts were just one source of these preparations (see Brunschweig, also Chapter 2). The formulation and proper provision of medicines required access to informed knowledge. This was beyond the bounds of a traditional craft hand-over especially as the increasing diversity of products now crossed boundaries

[12] Clear-eyed (lynx) inquirers.
[13] Fyrth, p. 108.
[14] Long, P. O. *Openness, Secrecy, Authorship: Technical Arts and the Culture of Knowledge from Antiquity to the Renaissance*, Baltimore: John Hopkins University Press, 2001, p. 248.
[15] Christophorous Parisiensis, *Opera*, Palermo: 1557.

between druggists and alchemists. After the printing of an early herbal in Latin verse,[16] newer compilations soon appeared in England.

From 1553 the earlier mandate under which Wardens of the Grocers [17] assisted '*Physitions in their viewe and searche'* of '*Poticarye…Drugges'* was affirmed.[18] Later, a compilation was under the aegis of the Royal College of Physicians from 1585, these being early examples of the tussles between the physicians and pharmacists as to who was in control of the standardised descriptions of drugs. Another four years passed before a grouping was designated to be responsible for the collection[19] and another four before a text was drafted for examination.[20] Since the reign of Henry VI the Grocers' Company had been in receipt of letters patent giving them the exclusive right of garbling. This covered the 'cleansing, separating and examining of spices and drugs'; in essence this could only be satisfied under the umbrella of a written quality standard, provided by the guidance of a standardised publication. This was lacking; the relevant legislation now merely provided for the city's appointee to 'garble and make cleanse the same'[21] an approach ripe for incompetency, or worse, to prosper. In the meantime Grocers who sold herbs achieved separate status in 1617.[22]

A definition of a pharmacopoeia would be as a repository of formulae for medicinal preparations issued under the authority of a publicly recognised body. The importance of such an anthology would be the elimination of threats to public health and the promotion of activities in accordance with approved procedures. While there had been some earlier efforts the first truly national compilation followed from the requirement of 26 April 1618 that all apothecaries[23] follow the official listing of drugs and preparations of the London Pharmacopoeia. The first edition listed almost 300 herbs and 1,028 simples (single-ingredient drugs). This was a start but not as impressive as it sounds for it would be left until the sixth

[16] Floridus, M. *De Viribus Herbarum*, Geneva: 1500.
[17] 32 Hen. VIII. c. 40 (1540) *Concerning Phisicians & their privilege: Apothecaries, Search of Wares of.*
[18] 1 Mariæ, st. 2, c. 9 §3 (1553) *An Acte touching thincorporations of the Phisitions in London*; *Wardens of Grocers shall assist in searching Apothecaries' Drugs.*
[19] Trease, G. E. *Pharmacy in History*, London: Baillière, Tindall and Cox, 1964, p. 110.
[20] Anderson, S. (ed.) *Making Medicines: A brief history of pharmacy and pharmaceuticals*, London: Pharmaceutical Press, 2005, p. 51.
[21] 1 Jac. I. c. 19 (1603-04) *An Acte for the well garbling of Spices.* The role of the garbler was to assure 'just measure and just weight' so as to prevent 'deceipt'. *Darcy* v *Allin* (1602) Noy 181.
[22] Koehler, C. S. W. Pharmacopoeias, *Modern Drug Discovery*, 5, 11, 2002, pp. 53-57 at 53.
[23] Apotheca: a place where herbs and spices were sold.

edition of 1788 to pay special attention to the use of chemistry in pharmacy.[24] In terms of the contemporary understanding of chemistry it is also not insignificant that this was the first authorised English-language edition (see next section).

Accused in a 1627 report to the College as being, one of the: 'other apothecaries…had in their shops compounds, substances…of the worst quality...' [25] Thomas Johnson responded in the best possible way. There was at the time great confusion in botanical nomenclature. Johnson (1600-43) took his admonishment, travelled and researched widely in Britain and then wrote the first systematic description of native plants which became the bedrock of the English apothecary. His 1633 *Herball* featured woodcut images (2,000 engravings, 1700 pages) and elevated an ongoing profession in product identification and thus allowed diagnosis, selection, blending and application. This text helped to prevent variable and erroneous treatment with drugs of spurious content. The direct observations in his vernacular treatment augmented a 1597 *herball*[26] and were distinguished by a wish to eradicate the preponderance of hearsay through a reorganisation in medicines' provision.

Coupled with Gilbert's attempted delivery of solutions to practical problems in compass use and geography,[27] these publications provoked a profound reinterpretation of what it meant to be a scientist in Elizabethan England. Certainly a substantial social advance was in train, but this was also a crucial point in the history of scientific endeavour and demonstrates that advances in one discipline, when published and communicated, frequently catalyse a growth in the tempo of wholly different pursuits. Indeed, triply so, for additionally, Johnson's publication was key in being a channel for those scientists who were not just explorers, but collectors. Also, unintentionally, he helped to accelerate the pursuit of the microscope, an event which once successful magnified numerous fields including biology, medicine and even astronomy. The third, especially crucial element, although later identified, noted the attributes consistent with success in botanical

[24] Koehler, p. 54.
[25] 2 April 1627, Pelling, M. White, F. *Physicians and Irregular Medical Practitioners in London 1550-1640* Database (London 2004), *British History Online.*
Accessed 11 August 2016.
[26] Gerarde, J. *The Herball, or Generall Historie of Plantes*, London: John Norton, 1597.
[27] The tables of a contemporary publication on 'Mercator's projection' supplied more immediately realisable practical advantage for navigators. Wright, E. *Certain Errors in Navigation…Detected and Corrected*, London: 1599.

pursuits: 'training in close observation, systematic examination, noting differences, detecting resemblances, exercising memory, judgement and reasoning faculties in order to draw a valid inference.'[28] The resulting coherence is not merely Gilbert's science in action, it is just as superimposable on the sister professions of medicine and law in requiring the *in situ* creation of thinking with a written perspective and dexterity in filtering the evidence.[29] Under the auspices of published scientific endeavour the impact of the potentially uneven pattern of a locally understood or drafted 'formulary' was gradually moving towards the harmonisation and reduced risk from a newer, national standing. Undoubtedly important, perhaps even more crucial was the grounding of a new philosophy whereby sometimes apparently mundane activities, deployed in terms of orderly methodologies, can inspire higher echelons in a more systematic pursuit of advanced scholarship.

3.2.1.5 Technical prosodies gather

These events suggest nevertheless an awakening, the final chapters of a mend-and-make-do approach to policy as scientific advances raised expectations and the executive needed to prosecute the advantage. These gains could only sustain and succeed under the auspices of the written word. Yet challenges remained. Having some difficulty were those attempts to foster agreement on founding a literary academy for the English language. A forerunner, meeting at the home of Robert Cotton was established possibly as early as 1572[30] before being dissolved by James circa 1604.[31] However the king was more agreeable circa 1616/17 and endorsed a new Corporation Royal to 'authorise all books and writings which were to go forth in print'…and…'to give the vulgar people indexes expurgatory and expunctory upon all books of secular learning.'[32] The urgency of this work could never

[28] Leach, C. Religion and Rationality: Quaker Women and Science Education 1790-1850, *History of Education*, 35, 1, 2006, pp. 69-90 at 89 citing: Henslow, J. S. Professor of Botany, Cambridge University, 1828 in Layton, D. *Science for the People: The Origins of the School Science Curriculum in England*, London: George Allen & Unwin, 1973.
[29] Thomas Sydenham (1624-89, the English Hippocrates) founder of modern clinical medicine in *Tracatus de podagra et hydrope*, London: 1683 liberated the profession from mystical doctrines by advocating simple remedies on foot of personal observation.
[30] A project touching a petition to be exhibited unto her Majesty for the Erecting of a Library and an *Academy for the Study of Antiquities and History founded by Queen Elizabeth*.
[31] Monroe, B. S. An English Academy, *Modern Philology*, 8, 1, 1910, pp. 107-22 at 107.
[32] Hunter, Rev. J. An Account of the Scheme for erecting a Royal Academy in England, in the Reign of King James the First, *Archaeologia*, 32, 1, 1847, pp. 132-49 at 138.

compete with national military or economic interests yet given James' enthusiasm it is unsurprising to see calls for a supreme authority to police its progress. Among the early membership were the aforementioned Coke, Sir Henry Wotton, several antiquaries, also John Selden and Kenelm Digby, several being enthusiasts of science, not just educational reform. This gathering did not prosper. Plague, treason, regicide and civil war number soft targets among their inevitable casualties. Of note, the early deliberations of this group occurred under the express rule that *the* question under deliberation must be critiqued by all members.[33] Furthermore, an archival recording of each dissertation was 'enter'd in a Book; that so it might remain unto Posterity.'[34] The value of a written record was no longer seen as the sole preserve of the law reports.

Later, the fledgling Royal Society became involved through a twenty-one - member group. Among the goals of the sub-committee was to improve grammar, orthography and lexicography.[35] One contributor, diarist John Evelyn (1620-1706) urged an inventory of words, their derivatives and symbols, in essence placing a corral on language. Specifically, '*in order to do this, someone* [should be] *appointed to collect all the technical Words.*'[36] That this effort quickly extinguished is clear from but a brief treatment of the committee's activities within the Society's conventional histories.[37] John Dryden (1631-1700, the father of English criticism) later decried the lack of the distinctiveness of 'prosodia, .a tolerable dictionary, or a grammar'. While Dryden deemed the situation tragic by the end of the century: ('The barbarous harlots crowd the public place')[38] Daniel Defoe (ca. 1660-1731) in the role of advocate for the welfare of his society, was less disconcerted by these handicaps and penned; 'the English tongue is not at all less worthy the labour of such a society [an Academy] than the French, and capable of much greater perfection.' He called for a controlling usage of words 'sufficient also to expose the innovations of other men's fancies; …with a sort of judicature

[33] Hearne, T. *A Collection of Curious Discourses written by Eminent Antiquaries*, Vol. I, London: 1773 (originally Oxford: 1720) p. v.
[34] Carlson, D. The Writings and Manuscript Collections of the Elizabethan Alchemist, Antiquary, and Herald Francis Thynne, Huntington Library Quarterly, 52, 2, 1989, pp. 203-72 at p. 214.
[35] See also the following treatment of John Wilkins.
[36] Evelyn, J. letter to Sir Peter Wyche [committee chairman], 20 June, 1665, *Diary and Correspondence of John Evelyn*, 4 vols. III, London: George Bell, 1887, pp. 159-62.
[37] Sprat, T. *The History of the Royal Society of London,* London: 1667 p. 40 did note: 'we generally love to have Reason set out in Plain, undeceiving expression'.
[38] Dryden, J. *The Third Satire of Juvenal*, 1693, 115.

over the learning of the age, and have liberty to correct and censure the exorbitance of writers.'[39] This was a voice of reason. It was also shortly to be out of fashion; political pressures will always trample over more polite activities like etymological arrangements.

The reign of Anne has been noted to be one of pronounced correctness. This fetish also extended to language. One ambition, harboured by amongst others, satirist Jonathan Swift (1667-1745) was to propose an academy to establish binding rules for English with any evolutionary progression to be centrally controlled. This misanthropic perspective ('Now Grub Street wits are all employed')[40] was unrealisable. The mystery is that this towering public figure was surely not ignorant of the working origins of the mother tongue and despite his indignation that human nature could not remain wedded to its inherent potential (Swift scorned the Whigs whose tolerance of Dissenters potentially threatened the Anglican Church) could have harboured such an obdurate perspective.

That such controls and denial of obsolescence were incompatible with newly felt opinions can be gleaned from subsequent commentary. Johnson noted: the organic evolution of language commenced with living speech; that a dictionary provided a means of fixity for recording these inevitable changes and permitted that 'our language be laid down, distinct in its minutest subdivisions, and resolved into its elemental principles…and …retain their substance while they alter their appearance.'[41] (See Table 2.1 for the 1755 publication of the lexicographic basis of the language.)[42] This new found subtlety recognised that the camber of language, under the curatorship of everyday use, was inherently impermanent and consequently must remain independent of the whims or foibles of academy or learned society-based opinion. It has been a mantra that in the history of jurisprudence, rights of property always come before rights of the person; here however, though not focussed on any specific case, the latent ownership and non-conformist entanglement of a society's communications took an inevitable precedence. In the history of patent jurisprudence, a judgment *re* inventiveness can reference the evidence, deciding whether there had been any prior use whatever of

[39] Defoe, D. *An Essay upon Projects*, London: Tho. Cockerill, 1697, p.236.
[40] Swift, J. *Verses on the Death of Dr. Swift*, 1731, 165.
[41] Monroe, p. 120 from Johnson, S. 1747, *The Plan of an English Dictionary*, also, *Dictionary of the English Language*, London: 1755.
[42] The Society of Antiquaries only received a charter in 1751.

the invention, in the ordinary, everyday, grammatical sense of the word. When weighing up validity, this approach must reconcile the rights, obligations, powers and proscriptions inherent within the relevant legislation; what an Act does and how it operates; and in modern times, the intention of parliament, all through the medium of the words read in the appropriate context.[43] Now at this era, among the general rules for patents were:

> *'…the grant to be taken in the most liberal and beneficial sense, according to the king's intent and meaning expressed in his grant'* and
>
> *[A]lthough in some cases the general words of a grant may be qualified by the recital, yet if the king's intent is plainly expressed in the body of the grant the intent shall prevail…* '[44]

Protection for the applications of technology therefore has required the nurturing of illustrative and understood meaning but paradoxically has also needed to accommodate an evolution of the suggestions and reach from thought-informed language. The reconstruction of an invention by a following practitioner could frequently remain in abeyance unless an adequate, detailed description was provided. Not triggered until John Nasmith's patent application in 1711[45] the equilibrium of sufficient disclosure would take some time to settle.

3.2.1.6 Distempers of learning

Bacon's *Instauratio Magna* (The Great Instauration) developed his central role as the preeminent commentator on the 'problem of knowledge' *via* a foundation of learning and experiment.

> In his earlier *The Advancement of Learning* he described how:
>
> '*men began to hunt more after words than matter* (the first distemper of learning) *and more after the choiceness of the phrase, and the round and clean composition of the sentence, and the sweet falling of the clauses, and the varying and illustration of their works with tropes and figures than after the weight of matter, worth of subject, soundness of argument, life of invention, or depth of judgment.*'

[43] For a systematic summary of statutory interpretation, see: *Principles of Legislative Drafting*, Office of Legislative Counsel, Province of British Columbia, August 2013.
[44] *R* v *Mussary* (1738) 1 Web Pat Cas 41.
[45] GB 387.

In essence he was railing against the influence of rhetoric; proper enquiry must seek sanctuary in the matter of things rather than words. Predictably, Bacon too disparaged alchemy as a pseudoscience.

An overly optimistic expectation that an 'orderly [collection and] arrangement of data would make the right hypothesis obvious' rendered Bacon's postulates incomplete.[46] Rather than casting the first stone, we must bear in mind that society was just entering that period after which much primary material routinely survives. These histories, incorporating ideas, sources and motivation must henceforth be more easily interpreted in terms of the social and cultural matrix in which the advance occurred. Now preserved as records, as demonstrated by the examples of Robert Norman and Thomas Johnson above, what was once intractable, obscure, or even secret, could, from this point be sourced, consulted, cross-examined and further influenced under the unity of scientific endeavour (as happened with Gilbert and the Pharmacopoeia). In demanding observation and written record, the experimental philosophies of Gilbert and Bacon had, with the support of early physicists and botanists between them, formalised a fissure between the medieval age and the future of science.

3.2.1.7 Solamona: the law-giver of New Atlantis

In 1627 the primordial yet panoramic focus of Bacon's last book[47] included components pertinent to technological descriptions, revealing in a literate hierarchy '…experiments of all mechanical arts, and also of liberal sciences, …into titles and tables, to give the better light for the drawing of observations…out of them.'

Among the necessities to sustain these efforts Bacon perceptively described an apprenticeship scheme and then, consultations:

> '*which of the inventions and experiences which we have discovered shall be published, and which not; and take all an oath of secrecy for the concealing of those which we think fit to keep secret; though some of those we do reveal sometimes to the State, and some not.*'

Bacon's prophetic; brocade of tidings to future inventors, noteworthy here for its proximity to the Statute of Monopolies, was thence a summons for a regularised,

[46] Russell, B. *A History of Western Philosophy*, London: George Allen & Unwin, 1946, p. 566.
[47] Bacon, Sir F. *The New Atlantis*, 1627.

collaboration of scientific minds. He saw this as a turning point of history. Earlier chapters in this writing have spelled out the formative influences of what Long has ascribed to the practice of authorship on the changing status of mechanical arts. For: 'when authors transformed craft know-how into forms of discursive knowledge, they prepared it for integration into philosophical methodologies pertaining to investigation of the natural world.'[48] Bacon was uniquely positioned to exploit this new reality, but he was also the key stimulus. In his eyes, law, like astronomy or chemistry, was a paid-up member of the scientific club, and thus was susceptible to the application of reason and the postulates of his new scientific method.[49]

In macro-terms his championing of the empirical approaches of the inductive method [50] instigated a rapid and profound influence on philosophy and natural science. To him may be ascribed the intellectual justification for the foundation of the Royal Society and the regular, rapid dissemination of technical literature.

3.2.1.8 Making sense of science

To this point, the wool-trade and clothmaking had dominated English industry for centuries. The emphasis and rudiments of mechanical operations had been on machines crafted from wood; with the voracious blast-furnaces attracting the opprobrium of forests-preserving legislation as late as 1581 and 1585. One argument is that it was the eighteenth century before calculation was required to support developments in apparatus, as from this point, advances in metallurgical knowledge opened new possibilities.[51] Prior to this, a penchant for easily available iron had prevented rather than promoted the appliance of mathematical methods,[52] a reality unlikely to foster an eruption of efficient transfer of industrial knowledge. The early pioneers of England's Royal Society had limited drivers (see Chapter 2 for Dee's legacy) therefore to introduce mathematical approaches into natural

[48] Long, p. 249.
[49] Shapiro, 1969, pp. 737, 748. Also: Shapiro, B. J. *Probability And Certainty In Seventeenth Century England*, Princeton, NJ: Princeton University Press, 1983.
[50] Matthews, S. *Theology and Science in the thought of Francis Bacon*, Aldershot: Ashgate, 2008, pp. 130-31.
[51] Zilsel, pp. 1-32.
[52] *Ibid.*

science. Given that the fusion of printing and the elements of geometry had realised the oldest scientific textbook in the world [53] and produced a standard of clarity that would remain unchallenged until 1829 this was not any great impediment.

Nevertheless, among the subjects discussed by the nascent gatherings of the Society were a number, many sufficiently quantitative that they could not be conveniently reduced to unambiguous discursive description due to their fundamental nature or association with discoveries, scientific theories or mathematical methods.[54] An extract of the proceedings noted:

> '*We there discoursed the Circulation of the Blood, the Valves in the Veins, the Copernican Hypothesis, …, the …Selenography of the Moon,…the Improvement of Telescopes, and Grinding of Glasses for that purpose, …the weight of the Air, the Possibility or Impossibility of Vacuities,… the Torricellian Experiment in Quicksilver, the Descent of Heavy Bodies, and the Degrees of Acceleration therein….*'[55]

These were undoubtedly big questions. They are also reflective of a change from interests first instigated in quantitative medical treatments such as William Harvey's[56] to newer revelations of the capabilities of human intellect and deduction. In effect planning permission was being sought for a cultural extension through the medium of open technical communication.

The sense of optimism, impressive scale of ambition and rigour in analysis was only realisable through the earlier discipline presciently imposed through the rules and examples of Bacon and Gilbert. For example, atmospheric experiments on quicksilver were ordered by Robert Boyle for Tenerife[57] with instructions to vary altitude and 'try…observe…note…repeat…' and 'note the difference.'[58] Now, with a hypothesis about to be formed *in situ*, natural philosophy was undergoing a newly self-augmenting synthetic process of enquiry. Armed with descriptions of

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[53]Euclid, *Praeclarissimus liber elementorum Euclidis in artem geometriae*, Erhard Ratdolt, Venice: 1482.

[54] Today, these would be likely classified as being beyond the scope of eligibility for patentable subject matter. Whereas a discovery is a disclosure that adds to the store of human knowledge, an invention also necessarily suggests an act to be done (*Reynolds* v *Smith* (1913) 20 RPC 123). The 1977 British Patents Act s. 1(2) so extends to a discovery, scientific theory or mathematical method, amongst other exclusions, but in each case only to the extent that the patent relates to that thing as such. This position is derived from EPC Art 52(2), (3).

[55] Attributed to one Dr. John Wallis from a 1678 meeting in: Fyrth, p. 110.

[56] Harvey, W. *De Motu Cordis*, Frankfurt, 1628.

[57] Sprat, p. 217.

[58] Anon, Review of the first & second volumes of Birch, T. *The History of the Royal Society of London*: *The Critical Review*, or *Annals of Literature*, 1, March, 1756, pp. 41-53 at 41-46.

previously observed phenomena, the conjecture of causality was used, through experiment, to predict the existence of further phenomena. The experimenters were in pursuit of knowledge in the form of reproducible data which could be analysed. Of necessity this required witness, in reality written record. When data stands the tests of discrimination and reliability it forms a basis for conclusions and publication. Information inherent to these iterative stages, once written down or, especially when printed, is annotated and assumes a particular permanence. From the perspective of this thesis, the later reader of ordinary skill in the relevant art needs the foundation of such supporting evidence so that their evaluation of the work is credibly informed. Replication of the ideas therein merely represents the initial steps in a quest for further advance.

Tensions abounded under attempts to achieve a disposition for these strands of an emerging revolution in thought. For, with the separation, *in situ* from antiquity, of the liberal and mechanical arts increasingly rendered unsustainable, a new ascension in technological progression was being negotiated. In addition, the longstanding prejudice directed against experiment (among perhaps all non-manual scholars but the alchemists) was eroding, not least on the coat-tails of published, applied advances that increasingly relied upon mathematical models of quantity and space, concepts that could not be adequately challenged within the confines of a library. Aristotle's reliance on deduction, where a single, original premise can lead to a whole series of propositions, was incompatible with the alternative, irresistible pathway of induction.[59]

Bacon, the radical empiricist[60] was going outside a solely utilitarian perspective as he recognised the worth of knowledge for its own sake. He felt an inevitable consequence of a cross fertilisation (of study by liberal minds) of the arts illiberal and mechanical would be propulsion of new discoveries and the invention of advances, with one contemporary noting that recorded histories must stimulate 'a large and an unbounded Mind…likely to be the Author of greater Productions, than the calm, obscure, and fetter'd Endeavours of the Mechanics themselves.'[61]

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[59] See Chapter 5 of Crump, T. *A Brief History of Science*, London: Constable & Robinson, 2001.
[60] Bacon may have had a role in demands for models and extended descriptions for patented inventions when *in situ* as a Law Officer (Seaborne Davies (III, 1934) p. 271) although this policy commenced just prior to his appointment as attorney general.
[61] Sprat, p. 392. Also available as: Cope, J. I. Jones, H. W. (eds.) St. Louis & London: Washington University Press, 1958&59.
See also Wilkins later.

In praising the capacity of the mechanical arts to live and grow, Bacon dryly observed the dangers of celebrating the static philosophers of intellectual sciences: 'they sometimes flourish most in the hands of the first author, and afterwards degenerate.'[62] Applied science (*scientia operativa*) was now being imprinted in the store of a receptive national psyche. For example, almost one-in-eight of treatises published in England between 1475 and 1640 concerned scientific subjects, ninety percent being in the vernacular.[63] The outcome was a natural progression, indeed imperative, to adopt less primitive methods whether for improver activities or for new extensions to the industrial base.[64] There would be no going back to a time when knowledge was allowed to compost in the dustbin of the Ancients.

Even his one-time protégé, amanuensis and later rival, Thomas Hobbes (1588-1679)[65] had to acknowledge the transformations underway when, in disavowing the inertia as he sat it of higher education, he:

> '*had a high esteeme for the Royall Societie, having sayd that Naturall Philosophy was removed from the Universities to Gresham Colledge, meaning the Royall societie that meets there…*'[66]

3.2.2 Gresham graduates: a golden symbiosis of innovators

3.2.2.1 Science before politics

Irrespective of the prevailing Civil War (1642-51) the Society was first mooted about 1645 by, in the main, a gathering of like-minded amateur enthusiasts who

[62] Bacon, Sir F. *Instauratio Magna* (Preface).
[63] Stearns, R. P. The Scientific Spirit in England in Early Modern Times, 34, 4, *Isis*, 1943, pp. 293-330 at 297.
[64] Nef, J. U. The Progress of Technology and the Growth of Large Scale Industry in Great Britain, 1540-1640. *Economic History Review*, 5, 1, 1934, pp. 3- 24 at 9.
[65] Hobbes, T. author of *Leviathan: Or The Matter, Forme and Power of a Common-Wealth Ecclesiasticall and Civill*, 1651. ed. Shapiro, I. New Haven: Yale University Press, 2010 suggested a structure of society under the rule of an absolute sovereign, something not altogether impossible in the era of the English Civil War. Hobbes' materialist perspective was to see him excluded from the Royal Society.
[66] Clark, A. (ed.) '*Brief Lives,' chiefly of Contemporaries, set down by John Aubrey, between the years 1669 & 1696*', Oxford: Clarendon Press, 1898, pp. 371-72 citing MS. Aubr. 9, fol. 54.

were also supporters of Parliament. Commencing weekly meetings in such an atmosphere may have seemed a peculiar course, but science has no politics and in any event it was not yet defined in terms of its modern understanding.

This was one contemporary perspective facing the early gatherings of the Society, sometimes at Gresham College in Bishopsgate,[67] otherwise in taverns or private lodgings. Under the auspices of Oliver Cromwell's brother-in-law, Dr. John Wilkins (1614-72) some members of the group were appointed to Oxford following a purge of *its* Royalists where, in 1651, they were to participate in the founding of the *Philosophical Society of Oxford*. Several years later some returned to London, where after meeting at a lecture by Christopher Wren in 1660, opinions were exchanged on the wisdom of forming an alternative 'college' in the capital.

3.2.2.2 Advantage adult education

Intellectual progress was about to nucleate around a prodigious fusion of ideas and possibilities. The practice and economics of long-prevailing traditional crafts, was about to witness the creation of a parallel track. Until the advent of printing, intellectual advances possessed a significant probability that their originators brought new ideas to the grave. Even if reduced to writing, such reproduction might be consigned to the relative inaccessibility of manuscript format or worse, remain as an aspect of private correspondence. Validating the foresight of Neri (Chapter 2) print had introduced a new denominator or as has been asserted, reliability was enhanced and the earlier, erratic impetus to future progress was removed.[68]

As a new pathway, the scientific method was about to nudge staid traditions into a concession of autonomy and would displace custom and practice with the momentum of human advancement. A crucial driver for this must have emanated

[67] It first hosted free public lectures in 1597. The original professorships were: astronomy, divinity, mathematics, law, music, medicine and rhetoric. Sir Thomas Gresham's mansion hosted lectures until 1768. One historian suggested that by the mid 1670s Gresham had '*declined from a seat of learning into a lodging house*' apparently due to the amorphous nature of the accommodation arrangements pertaining. Shapin, S. The House of Experiment in Seventeenth-Century England, *Isis*, 1988, 79, 3, pp. 373-404 at 381. The Royal Society met here from 1660-1666 and again from 1674. See also
http://www.gresham.ac.uk/about-us/about-gresham-college
Accessed: 24 October 2016.

[68] Ornstein, M. *The Role of Scientific Societies in the Seventeenth Century*, Chicago: University of Chicago Press, 1928 repub., from 1913, p. 199.

from the presence of diverse artisans from around the ever-expanding city, who, in attending lectures at Gresham and, undoubtedly attracted by a new fashion of curiosity, became the first customers of formal adult education in the country. Their return to the workshops can only have driven an appetite for a cross-fertilisation of conducting trials and continuous innovation, actions of a lower probability prior to the evaporation of the shadow of the guild warden. Henceforth this new philosophy of interrogation and experimentation would be an early life-support for the freedom and true utilitarian underpinning of scientific advancement.

By now Charles II was restored, so unsurprisingly it was one of the few Royalists in the group who was requested to seek the king's *imprimatur* for its formal institution at Gresham. The Royal Charter for the Establishment of the *Royal Society of London for the Promotion of Natural Knowledge* was signed on July 15th 1662.[69]

In affirming that patent historian's perception of the critical status of the Royal Navy by the mid-seventeenth century, a substantial proportion of Woodcroft's compilation of entries onto the Index of Patents of Invention (see Cumulative Resources & this chapter) concerned nautical innovations. This reality also intersected the working arena of the preeminent commentator of this period, Samuel Pepys.[70] It is more likely however that the substantial weight of Pepys' interest in and oversight of naval novelty had had an earlier beginning. For, although he had relinquished his post at the Privy Seal Office in 1662[71] his was a track record of continual interest and influence in the recorded minutiae of progressive thought.[72] This lineage was ultimately to be recognised in the

[69] Founded in 1660 as the *Invisible College for the promoting of Physico-Mathematical Experimental Learning*, and becoming the *Royal Society of London for the Promotion of Natural Knowledge* when Charles sealed its charter. The evolution of the granted charters is obtainable at: *http://royalsociety.org/uploadedFiles/Royal_Society_Content/about-us/history/Charter1_English.pdf*

Accessed: 24 October 2016.

[70] Pepys (1633-1703) is the most renowned diarist in English letters. From 1660 to 1669, this wordsmith recorded a cumulative depiction of Restoration London, its turbulence and its intrigues. As late as 1825 scarcely half of the manuscript was printed.

[71] His two-year sojourn commenced on his swearing in on 24 July, 1660. A biography may be found at:
http://www.historyofparliamentonline.org/volume/1660-1690/member/pepys-samuel-1633-1703

Accessed: 24 October 2016.

[72] He recognised that education, formal training and objective assessment through examination were required for naval officers if a professional force were to be realised. The issue was magnifying as

momentous year of 1684 when he returned to commence a second term as secretary of the Admiralty and was elected president of the Royal Society. The head when Isaac Newton's *Principia Mathematica* was published, diarist Pepys invited other members to contribute ideas for making experiments. He initiated attempts to get the assembled brains to improve his beloved navigation, drawing much gratitude: 'Mr. Pepys put this ships and docks in the greatest order beyond what can be expressed.'[73] This prestigious role, remains one for which the diarist is much less famous for than his unique literary contribution and role in transforming the Royal Navy.

Noted by now for his administrative skills Pepys had become a Fellow of the Society in 1665. Perhaps the trigger for his initial involvement had been his contacts with an inheritor of the approaches of William Bourne.[74] In 1660 he observed several engines at work in St. James' Park, with that of mathematical instrument-maker, Ralph Greatorex: 'which is one round thing going within all, with a pair of stairs round; which being laid at an angle of 45°, do carry up the water with a great deal of ease', impressing.[75] The intersection of description and geometric properties stands out. Just three months later Pepys first visited Gresham after socialising with Greatorex, finding 'great company of persons of honour there'.[76]

Given the preponderance of radical thinkers there was a feeling that the parliamentary cause was inexorably linked with experimental science so it had to operate independently of overt royal patronage.[77] It was a subject of suspicion, not least from the Royal College of Physicians, a body more closely aligned with the Royalist cause. Given the lack of funds it is no surprise to note the conduct of chemistry experiments in Pepys' house at Buckingham Street. The fusion of cooperation and sense of free enquiry is however best exemplified in that early

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plunder of East India Company shipping by pirates was more probable as other nations' fleets and crew were superior at this point. Despite resistance by aristocratic officers, Pepys, just as he had to fight parliament to release funds for new warships, prevailed. See: *Everybody's Pepys, The Diary of Samuel Pepys 1660-1669*, op. cit., 5 Mar. 1668, pp. 508-11.

[73] Bryant, A. *Samuel Pepys: The Saviour of the Navy*, London: Collins, rev. edn. 1949, p. 235.

[74] Chapter 2.

[75] *Everybody's Pepys, The Diary of Samuel Pepys 1660-1669*, op. cit., 11 October 1660, p. 59.

[76] *Ibid.*, 23 Jan. 1661, p. 75.

[77] Charles was privately interested to the extent that he possessed some scientific apparatus and did act as a patron although he never attended a meeting. Tomalin, C. *Samuel Pepys the Unequalled Self*, London: Penguin, 2003 (First published Viking: 2002) pp. 254-5. Uglow describes one (unimpressed) attendance at Gresham to view 'pure' research suggesting he wanted more by way of applied advances. Uglow, J. *A Gambling Man*, London: Faber & Faber, 1999, pp. 241-44.

fellows of the Royal Society were colloquially termed 'Greshamites' with the early scientific chairs (physic, astronomy and geometry) being especially productive at Gresham. This was the realisation of an altogether necessary equalisation of the status of the applied and eventually, illiberal pursuits. For while Linacre (Chapter 2) had founded lectureships in medicine at Merton College, Oxford and St. John's College, Cambridge in 1518 and a lectureship in surgery had been created at the Royal College of Physicians in 1583, there was no equivalent foundation for astronomy[78] and geometry until 1619.[79] Beyond the exalted status of medicine the exigencies for scientific activation were certainly quite high.[80]

3.2.2.3 Burrowing into national prosperity

Among the other individuals associated with the fledgling society were chemist and physicist Robert Boyle (1627-91)[81] his assistant Robert Hooke (1635-1703), architect and astronomer Christopher Wren (1632-1723)[82] mathematicians John Wallis (1616-1703) and William Brouckner (1620-84, the Society's president) social scientist John Graunt (1620-1674) and professor of anatomy at Oxford and the pioneer of statistical method, William Petty (1623-87). Some two-thirds of the early Fellows were Puritan. In an alternative muster some one-third were not scientists in the conventional sense; these included diarists Pepys, John Evelyn and the Poet Laureate, John Dryden. This was a highly potent collection of intellects uniquely positioned to possess scant value for ancient precepts (see Linacre, Chapter 2).[83]

The fruits of an inevitably ardent interrogation of natural philosophy needed fostering. The channel of communication for the new cultivars was the

[78] The Gresham professor of astronomy was Edmund Gunter (Chapter 2).
[79] The Savilian Professorships at Oxford; endowed to Briggs (Chapter 2) who departed Gresham.
[80] Perhaps in acknowledgement of future commercial dividend, the Mercers' Company was responsible for the selection and stipend for the professors of law, physic and rhetoric.
[81] Boyle was a royalist but more so a 'natural philosopher'.
[82] Wren was president for two years from 1680, membership was shrinking and many were in arrears.
[83] Perhaps the most strikingly effective persona resided with Petty (see later) for his activities in seeing a '*connection between scientifically acquired information and the effective mastery of government'*. Educated by Jesuits, he served in the Royal Navy and qualified as a physician. Still in his twenties, he moved to Ireland as Physician-General to the army. There, he presided over the dispossession of the entirety of defeated Irish landowners; his effort described as '*…a map of population, ownership, land and beasts such as had never been seen before in British history.'* Schama, S. *A History of Britain 2 1603-1776: The British Wars*, London: BBC Books, 2001, pp. 191-93.

Philosophical Transactions of the Royal Society of London which was launched on March 6th, 1665. This first edition prefaced:

> '*…there is nothing more necessary for promoting the improvement of Philosophical Matters, than the communicating to such,… things as are discovered or put in practice by others; it is therefore thought fit to employ the Press…as the most proper way…to delight in the advancement of Learning and profitable Discoveries…encouraged to search, try, and find out new things, impart their knowledge to one another…*'[84]

This was not to be a local affair as show by the first entry concerning shipworm prophylaxis; a *letter* borrowed from the parallel French *Journal des Scavans* with a vague suggestion of '[P]itch, drawn out of Sea coles'.[85] The shipworm had been of particular import for a country so dependent on its nautical inventory and prowess; it would feature in numerous entries of Woodcroft's later index; with the suitably connected grantees of Howard and Watson even inclined to seek the protection of a Private Act[86] to sustain their patented, hull-coating (with the entering of a description of the manufacture in the Court of Exchequer). It is noteworthy that they availed of this particular mechanism even though their invention had been the subject of litigation during which the patentees felt obliged to pursue infringing actions of the Company of Painter-Stainers of London.[87] In an early example of marrying patent jurisprudence with the awareness of the importance of procedural steps and technical drafting, an investigating committee sought *written methods* of varnishing from each party but the defendants demurred. An aversion to written methodology is apparent but clear also was the vector through which the investigators sought to reach a decision. Significant too, the substantial occurrence of the Bill (on behalf of Howard and Watson) being read in the Commons ten

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[84] *Philosophical Transactions*, 1 (1665-66), Royal Society.
[85] Anon, An Extract of a Letter, Written from Holland, about Preserving of Ships from Being Worm-Eaten, *Philosophical Transactions*, 1 (1665-66) pp. 190-91.
[86] 22 & 23 Car. II c. 7 Pr. *Granting Sir Philip Howard and Francis Watson sole use of an invention for the benefit of shipping*.
GB 158* [1669, Jan.1] though dated 1670. No specification was enrolled (Woodcroft, B. *Patents for Inventions: Abridgements of the Specifications relating to Ship Building, Repairing, Sheathing Launching, &c.* London: Great Seal Patent Office, 1862, pp. 4-5. p. 5) yet the composition has been described as a '*lacker*' in the Act and does specify the qualitative dissolution of '*bees-waxe, frankincense, turpentine, and seedlack'* and the co-preparation of '*linseed oyle, redd lead, white lead, and whyting'* for treating seams and planks covered with '*sheetes or plates of lead*' secured with nails made of brass, copper or tin. Furthermore, the patentees were required to submit within three months from the First day of February, following, '*the said, manufacture, art, or invenčon*'.
[87] Hulme, E. W. Privy Council Law, Part I, p. 68.

months later (7 November) and seemingly provoking an order (26 November) that certain MPs be 'added to the Committee to whom the Bill…for Encouragement of an English manufacture for Preservation of Shipping…was committed.'[88] This was a noteworthy coalition seeking to discern the veracity of empirical approaches to retain naval prowess, an aspiration vital to national interest.

3.2.2.4 Natural philosophers getting published

Some early articles included: (i) *The heads of many new Observations and Experiments, in order to an Experimental History of Cold, together with some thermometric discourses and experiments*; (ii) *Of a peculiar Lead Ore in Germany, very useful for essays.*[89]

Science and technology were no longer an obscure footnote or swaddled in the restrictive licence of oral tradition.[90] The experimental philosopher now felt free; knowledge built on works impelled one 'to augment, to apply…to communicate itself by more works.'[91] Once started, as the *Transactions* was a cumulative record, science could reflect back in order to look forward. Aside from its literary content, through its coupling with illustrations and the legacy of geometrical arrays bequeathed by Ramus,[92] a combination of ample, inclusive description, and response, was now available to the curious.[93] Of necessity, the presentation and any response were topic-specific. This conciseness and its accessibility[94] was a notable adjunct to root causes of the later debates on patent rights as the Industrial Revolution proper started.[95]

Given both the challenging politic and it not being the *raison d'être* of this publication, the frequency of citation for the term patent (of invention) was initially

[88] House of Commons Journal, Volume 9, 1667-87, London: HMSO, 1802, pp. 170-72.
http://british-history.ac.uk/commons-jrnl/vol9/pp160-161
http://british-history.ac.uk/commons-jrnl/vol9/pp170-172
Accessed: 24 October 2016.
[89] *Philosophical Transactions,* 1 (1665-66), Royal Society, pp. 8-10, 10-11.
[90] One irony was that the inception of a published medium, just as the debate about copyright was increasingly prominent, helped to pivot the establishment of private property in ideas.
[91] Sprat, p. 336.
[92] Chapter 2.
[93] Auzout, Considerations of Monsieur Auzout upon Mr. Hook's New Instrument for Grinding of Optick-Glasses, *Philosophical Transactions,* 1 (1665-66) pp. 55-56 & 57-63.
[94] Under secretary Oldenburg's stewardship one hundred and thirty-six monthly editions were published (1665-77) with Latin versions in Amsterdam, Frankfurt (1671) and Leipzig (1674). Ornstein, p. 128.
[95] The first index of patents (1617-1852) was published in 1854.

low, the earliest being the noting of a request for a patent for new navigational apparatus which noted: '…and that without any difficulty they (unidentified States) have granted my request, commanding me to bring one of these Watches into their Assembly, *to explicate unto them the Invention…I have this week published,…Information necessary to use them at sea…*'[96] Three years later, in a notably expanded geometric treatment with calendar, the same topic was reappraised: 'together with a Method of a Journal for such Watches.'[97] This event seems to suggest the typical absence of a requirement to submit written detail including, unsurprisingly, when seeking a patent for a device small enough to at least be demonstrated, but it also shows the formalisation of recording data when needing to use and/or validate the outcomes of such actions. And therein may lie another tale, for it seems not everyone involved in this important pursuit could avoid the lucre attributed to the promise of new inventions. For this English patent was in the name of Abraham Hill, Fellow of the Society[98] and contained an extraordinary melange of inventions; covering '*coaches, …guns…and a new pendulum for exact measureinge of tyme and finding out the longtitude, to bee used at sea…*' amongst others. Administratively this was an omnishambles. The granting clause was extraordinarily lengthy with the pendulum component receiving the most comprehensive description. Yet irrespective of any due merit, this affair was the apex of the improper fashion of Stuart grant to the individual rather than the subject-matter of invention. No amount of perfection of language or inclusiveness of description could prevail with such hubris but as for any apogee a new horizon would eventually come into view.[99]

Although paralleled in some other countries, the Society as a critical mass was unequalled, and facilitated one of those quantum leaps forward which are quite infrequent in the narrative of technological evolution. As the draft preamble to its just published Statutes from 1663, reflected:

[96] (Describing the invention of Christian Hugens, its adaptation by the Earl of Kincardin and its earliest use by a Major Holmes.) A Narrative concerning the success of the Pendulum-Watches at Sea for the Longitudes; (and the grant of a Patent thereupon), *Philosophical Transactions*, 1 (1665-66), pp. 13-15.
[97] Instructions Concerning the Use of Pendulum-Watches, for finding the Longtitude at Sea, *Philosophical Transactions*, 47, 10 May, 1669, pp. 939-76.
[98] GB 143 [1665 3 March] incorrectly dated 1664.
[99] See: *Morgan* v *Seaward and Others* later.

> '[*T*]he *business of the Royal Society is: To improve the knowledge of naturall things, and all useful Arts, Manufactures, Mechanick practices, Engynes and Inventions by experiment-(not meddling with Divinity, Metaphysics, Morals, Politics, Grammar, Rhetorick or Logicks*).'[100]

Pepys' role was vital for an institution which has prevailed to this day, for during its formative decade it almost folded and required his influence and administrative capacity (rather than his interest in naval optics) to take root and sustain. His intimate association with naval matters is also relevant. The absence of a regularised recording format for methods of manufacture or 'bills of materials' for recipes of composition may have played second fiddle to timber supply and protection of hulls. In tandem with the absence of clear citation, this oversight can have done little to accelerate the incremental adoption of innovations necessarily encapsulated and (there were subsequent entries through 1779) newly revealed in a formal written description.

It would be naïveté to expect anything else. For, while Isaac Newton (1642-1727) produced his *magnum opus*[101] under the imprimatur of Pepys' Royal Society, the 1687 *Principia* was in Latin. Acknowledged as one of history's most important publications, Newton established the relationships between mass, force, and direction. This was a tome for specialists in the science of motion. Once it arrived in the more accessible form for the general reader in 1728 it elevated thought and accompanying description to a new appreciation, indeed dominance. Among Newton's near legacy was an enterprising spirit for tackling problems, fortuitously just as demand was multiplying. Sandwiched between the original and vernacular *Principia* there arose Nasmith's application which drew down the request for a detailed description for the advance claimed for his sugar patent[102] a demand which gave birth to that procedural protocol which became increasingly prevalent thereafter. So while there is no overt link between Newton's powerhouse treatise on motion and mechanics and more rudimentary contemporary innovations such as Nasmith's and Darby(s) (see following) the unalloyed fact remains that Newton had promoted the acceptability and desirability of suitably moderated experimentation across any technical domain in pursuit of innovatory stimulus.

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[100] Attributed to Robert Hooke in: Brown, H. *The Wisdom of Science: Its relevance to Culture and Religion*, Cambridge: University Press, 1986, p. 131.
[101] Newton, I. *Philosophiae Naturalis Principia Mathematica*, London: 1687.
[102] GB 387 [1711].

A key bridge to the utility of a technical vernacular had been spanned. More importantly, it left supposition in a tailwind of the scientific method as understood today. Staggeringly, this one individual's new, universal approach to mechanical philosophy had already defined the activities of the Society in disavowing attempts to explain properties of natural phenomena by hypotheses alone. For Newton's Laws of Motion were focussed on a reasoning that required proof by reason, research and trial. Experimental evidence, of necessity written down and recorded, would from now be the cornerstone for practitioners of science. His quantitative approach was a key moment but as shown gradually throughout this writing he was fortunate in being an heir to numerous determined, even unremitting predecessors. The outcome for this thesis is that the spectrum of innovative development ranging from the mechanical to the astronomical would henceforth perpetuate on a foundation and status of cemented and recognised character which has sustained ever since.

Earlier, the neoteric Society's scientists found themselves engrossed in a plethora of practical problems very many of which also had a clear bearing on naval prowess. Though targeted at quite narrow objectives, such requests proved important for scientific understanding. For instance, Merton has noted that the manifest value of the problems requiring attention necessitated a broad spectrum of scientific responses:

> '*If the scientific study of various possible means of achieving this goal was not invariably dictated by the practical utility of the desired result, it is clear that at least part of the continued diligence exercised in these fields was due to it.*'[103]

Furthermore the Society 'employ'd much time in examining the Fabrick of ships, the forms of their Sails, the shapes of their Keels, the sorts of Timber, the planting of Firr, the bettering of Pitch, and Tarr, and Tackling.'[104] The accumulation of diverse minds at the Society tackling unified problems in tandem, created a vein through which the rich flow of science-supported innovation encountered minimal turbulence and emerged to bear substantial fruit. The natural philosophers such as

[103] Merton, R. K. Science and the Economy of Seventeenth Century England, *Science & Society*, 3, 1, 1939, pp. 3-27 at 18.
[104] Sprat, p. 150.

Newton (ultimately this title gave rise to the first use of the term scientist[105] by Cambridge philosopher William Whewell (1794-1866) in 1834) of the Royal Society had, it is argued by some, inherited just part of the mantle bequeathed by Bacon.

Of course invention and demonstration of a new and useful device or manufacture is one thing; its transformation into a vendible apparatus an altogether different challenge. A self-abnegating scientific mind might not sit comfortably with the approach of the profit-driven entrepreneur. The latter also requires innovation of outlook from the consumer. The burden of this thesis has been to demonstrate that this is where the writing down of know-how for dissemination across an increasingly widely-read and receptive populace, was vital to the prosecution of technological progression. Books, journals and demonstrations had their niche roles in this journey. It was not reasonable to expect the basic and applied to forever hold hands; a separation onto avenues such as the later 1754 founding of the Society of Arts was inevitable for these one-time acquaintances.

3.2.2.5 Doing what its says on the tin

There remains, in his zeal to ensure an adequate menu of original research for members and visitors to opine on at the Society's meetings, the crucial role of the pressure exerted by the Royal Society's second secretary, Oldenburg. There is a possible naiveté in his proposal 'that a proper person might be found out to discover plagiarys, and to assert inventions to their proper authors.' Undaunted, the following motion followed:

> '*when any Fellow have any philosophical notion or invention not yet made out, and desire the same, sealed in a box, to be deposited with one of the secretaries till perfected, this might be allowed, for better securing inventions to their author*.'[106]

So the Society, while comprised in large proportion of those of means and who could incur, at least in part, the expense of experiment, and who sought to explicate by public demonstration, was, in the persona of their administrator-in-chief, fully

[105] Singer, C. J. *New Worlds and Old*, London: Heinemann, 1951, p. 27.
[106] Birch, T. *The History of the Royal Society of London* [1660-1687] London: (4 vols.) Vol. IV, A. Millar, 1757, repr. Brussels: 1967, II, p. 24.

aware that the security of a property in ideas could not be conveniently divorced from the value conferred by the written word.

These precautions were soon supplemented by one defining safeguard which has been underestimated by researchers of the interdisciplinary requirements of administering the activities of a society accommodating a diverse range of disciplines. The contribution of Evelyn to the Society's committee on an English Academy has been noted earlier; yet this group seems to have progressed independently of Bishop John Wilkins's effort[107] at unifying the form and reach of language for submissions in natural philosophy to the Society's activities. As was now the wont of technical tomes, much of the 'reduction and description' was to tabulations of 'natural bodies'. This 'great undertaking' defined the difficulty in having inventions accepted at large until considerable time has passed; specifically detailing those English entries of logarithms (Chapter 2) and shorthand. As one signpost for the state of technology and how it was described locally, the *Essay* noted just six natural (elemental) metals but the greater interest perhaps lie in its compilations of what might be termed unit operations in matters mechanical and various practical activities, including units of measure. 'Chymical operations' are presciently and efficiently detailed in the manner of a ready reckoner as deployable by an apothecary in the preparation of medicaments: '…the changing of bodies, with respect to the Position and Figure of their minuter parts.'[108] Curiously, Wilkins' was substantially a solo effort, with one suggestion[109] that it would have required a 'supreme authority' to prosecute it; an unrealisable Hobbesian[110] wish.

[107] Wilkins, J. *An Essay Towards a Real Character And a Philosophical Language*, London: Royal Society, 1668.
[108] *Ibid.*, p. 248.
[109] Monroe, p. 113.
[110] Hobbes, *Leviathan* (*supra* note 64).

3.3 The ascent of artisanship: The Lunar Society

'Till about the year 1649 'twas held a strange presumption for a man to attempt an innovation of learning'.

Sir John Aubrey (1626-97) *Natural History of Wiltshire* (1671).

3.3.1 Albion's actual and accidental attributes

3.3.1.1 Firing innovation

In the years leading up to the Civil War yields of metallurgical products were progressively dependent upon coal.[111] As sources were increasingly identified, the dimensions of furnaces magnified, thus opening new possibilities for engineering materials rather than just smaller utilities and crafts' articles. However, even though escalating access to machinery ameliorated the unit labour costs of producing metal from ore, any advantage derived from labour-saving devices in mining 'were offset by the increasing difficulties of extracting coal and ore from great depths.'[112]

There was however an internal contradiction related to the accessibility of this cheap source of energy. For it has been claimed that the substitution of coal for wood as fuel, with attendant furnace supervision delegated to unskilled stokers, tended to remove the prestige associated with manual working and facilitated an enlarged throughput of lower quality products such as glass,[113] notwithstanding the benefits to the population as a whole. The paradox arose in that from the decades thereafter, there was a transformation in the aptitudes of English mechanical technicians; with visitor François Marie Voltaire the *philosophe* (1694 -1778) extolling their virtues and drawing favourable parallels of their capabilities with the intellects of the era's premier scientists such as Newton, who of course were also devoting quotients of their time to problems at the contours of energy, manufacturing and naval prowess.[114]

The drivers for the emergence of this bifurcated *pari passu* may be complex and under influence from Bacon and even Vives, yet may be partly attributed to the

[111] Demand for timber was continuous as were attempts to oversee coal quality to the extent that a Royal Surveyor & Seal were *in situ* circa 1616. Cunningham, pp. xxviii, 301, 528.
[112] Nef, p. 14.
[113] *Ibid.*, p. 18.
[114] Davidson, I. *Voltaire, A Life*, London: Profile Books, 2010, revised edition 2012, p. 92 citing Voltaire, *Letters concerning the English Nation*, ed. Cronk, N. Oxford: 1999, p. 30.

innovative efforts necessitated by the scarcity of wood and the fortuitous availability of an alternative calorific font. For by now, smelting had reached a plateau. Any necessity to introduce innovations in attempts to substitute coal for wood in metallurgy resulted in important related progressions. These included: battery and wire work; the conversion of iron to steel; and especially, finishing processes.[115] It is difficult to overlook the advantage that must have come about from the efficient application of scientific capability among the supervisors and practitioners of the previously illiberal, mechanical arts now about to come under the inspiration of a cadre of technology-inquisitive, scientifically-literate business leaders with a monthly ritual of exchanging thoughts near the full moon, the Lunar men.

3.3.1.2 The curriculum of Non-Conformist communication

The Non-Conformists established their Dissenting Academies after the 1662 conformity legislation, drawing the best teachers from the grammar schools. Those at Warrington, Northampton and Daventry taught a curriculum wholly divorced from the indolent offerings at the universities: modern languages, modern history, commercial arithmetic and experimental sciences. Among the more favoured disciplines were chemistry (see later) and botany (see the earlier treatment of pharmacopoeia). Some congregations had the self-assurance to prompt their youth to 'reason and arrive at their own judgements.'[116] Ironically for a belief system which set no store in a liturgy, their approach allowed God's word to be 'reinterpreted and revealed anew to each generation.'[117] This was a fertile soil for seeds of scientific thought to root and divulge a new future. For example, the curriculum encompassed site visits and exposed the students to a scientific treatment of the world around them.[118] Small wonder that the advances begat key personalities in the fields of technology and more broadly, requisite intellectual and social standing.

[115] Nef, p. 15. Given the rate of expansion there were shortages of skilled labour and the need for ongoing innovations in engineering machinery.
[116] Leach, p. 79.
[117] *Ibid*., p. 72.
[118] *Ibid*., pp. 79, 86.

With problems of mining, marine and military predominant among those selected by the Royal Society to 1687 [119] it could be argued, with the probable exception of lighting, that the populace had not felt much by way of improvements to their daily life from the early innovations in science and engineering during the preceding decades of the seventeenth century. A transformative process by Abraham Darby may have altered the mood. This Quaker ironmaster smelted iron with coke, rather than charcoal, but more importantly here, fashioned with sand in moulding boxes, instead of in clay on the floor. As the patent[120] described: 'iron bellied pots and other…ware may be cast fine and with more ease and expedition, and may be afforded cheaper…' Furthermore, the end-product was stronger, more precise and intricate (an important attribute for the efficacy of later engines such as Watt's). Such advances combined with the increasing scale of 'factory' operations together with a disperse availability of coal, transformed the country, resulting in opportunities across many enlarging urban centres and diluting the imbalance inevitably caused by the on-going expansion of the capital. Given the nature of the effort and the principal involved this is an example of an enterprising individual who had no truck with the reasoning of the Ancients; rather he was prepared to unify the nucleus of experimental philosophy with a practical problem through observations subject to the senses, brought to bear in his workshop and all suitably recorded.[121] The transfusion of thought induced by Gilbert and Bacon were entirely compatible with the advance of higher-order thought and the good of humankind, but this did not mean they must be denied to the technical arts.

[119] Merton, p. 25.
[120] GB 380 [1707] Darby, *Casting Iron Bellied Pots in Sand only*.
[121] The method was eventually perfected by his son and grandson but did not become common knowledge until the second half of the century.

3.3.2 Given energy, anything is possible

The fuse had now been laid on Britain's union with iron. The detonator of a functioning patent system was almost primed; the written description requirement would shortly be lit.

3.3.2.1 Plumbing the depths of discovery

The noteworthy catalyst for the Industrial Revolution was a steam-pump, powered by coal and which was made by Thomas Savery (1650-1715) in 1698.[122] This was a substantial advance but had limited practical application as the water-raising potential was restricted to 9-10 metres.[123] Nevertheless, the door had been partially pushed open, not least as he filed a patent worded so all-embracing that it claimed *any* use of steam to raise water.[124] Intriguingly, Savery was to successfully demonstrate his advance the year after his grant using a small model at the Royal Society. Although devoid of dimensions, this demonstration, when published, did include elaborate figures of the shell of the apparatus and would have reduced the concept into something tangible yet not immediately accessible to the reader.[125] Presumably secure in his attenuated disclosure, Savery's patent was sufficiently broad so as to prevent Thomas Newcomen (1663-1729) from manufacturing the first true steam engine in 1712.[126] What was different about the invention was that although mostly bereft of an understanding of the thermodynamic principles involved, Savery had formulated a machine, taken a suitable, compatible natural product, consumed it using the apparatus expressing his design, yielding a net benefit (work) which thereby facilitated admission to energy-demanding, mechanical actions, including potentially those extractive processes to further

[122] See Private Act 10 Will. III c. 31 (1698).
[123] This was still a major advance. As a validation of the oft incremental nature of even major steps forward in technological undertakings the French Huguenot refugee Denis Papin had in 1707 published '*The New Art of Pumping Water by using Steam'* a follow-on from his 1690 '*De novis quibusdam machinis'.* However, his air-cooled piston chamber was inadequate and the engines barely worked as a result of leaks. Winston reports that several of Papin's papers were put before the Royal Society but his contribution was never properly acknowledged. Winston, pp. 286-88.

[124] GB 356 [1698]. See Spear, B. James Watt: The Steam Engine and the Commercialization of Patents, *World Patent Information,* 30, 2008, pp. 53-58 at 54.
[125] Savery, T. An Account of Mr. Tho. Savery's Engine for raising Water by the help of Fire, *Philosophical Transactions,* 21, 1699, p. 228.
[126] Admittedly Savery's heirs agreed to a license after his death. Scotchmer, S. *Innovation and Incentives*, Cambridge, MA: MIT Press, 2004, p. 14.

access an excess of the raw material (coal) or equivalents, realising a substantial financial dividend and all in a safer mode for the worker (miners).

Later in the following century, patent abolitionists would argue that an invention was really the expression of a discovery rather than a creation. One commentator's contribution to this later debate stipulated:

> '*an inventor in fact does not create but only invents or finds out something which had a prior existence, although unknown to the world in precisely the same way as persons make discoveries in geography or astronomy'.*[127]

Other interpretations from this era of the merits of the originator's role are encapsulated in the position that: '[T]he Patentee must himself make the discovery or invention; the idea of it must originate in his own mind.'[128] Small wonder the brilliant yet non-divulging psyche of Watt sought to have his inquisitiveness sated at a gathering where it had long been standing orders that 'the Society will not own any hypothesis' and reports of experiments be …'matter of fact [and] be barely stated'.[129] Whatever the merits of the arguments seeking to divorce these twin elements of how imagination might be deployed and its fruits recorded by the creative individual, it is inarguable that (quoting Sherman & Bently) 'as scientific discoveries were pre-existing and waiting to be revealed, if Watt had not invented his famous Steam Engine, someone else would eventually have done so'[130] a quest indeed quite contemporary to his own era.[131] Watt's position in the history of patent litigation is frequently mooted, yet, aside from his personal and scientific attributes what were the stimuli which led to his ubiquity in such recordings?

Then as today, access to fuel was to be the key. An improvement to Savery's pump was soon forthcoming in the form of a surface-mounted variant designed by Newcomen which was sufficiently large to be capable of raising water in excess of 50 metres. Obviously the mining fraternity were intrigued, as deposits previously inaccessible would now become available. In any form of extractive

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[127] Hindmarch, W. *A Treatise on the Law relating to Patent Privileges,* London: Stevens, 1846, p. 228.
[128] *Jones* v *Pearce* (1832) 1 Web Pat Cas 122 at 124.
[129] Hooke, R. manuscript papers, 1663, cited by: Weld, C. R. *A History of The Royal Society*, London: 1848, I, 146, & II, 524 ff.
[130] Sherman, B., Bently, L. (1999) p. 152, also adds that Carpmael had argued that a clear distinction existed between '*the discovery of one of nature's laws and its application to some new and useful purpose'.* Carpmael, W. 'The Law of Patents for Inventions: Part III' (1835) 3 *Repertory of Patent Inventions,* p. 243.
[131] Robinson, E. Musson, A. E. *James Watt and the Steam Revolution*, London: Adams & Dart, 1969, p. 9.

process as soon as surface deposits attenuate towards exhaustion, and mining efforts must penetrate deeper, it becomes progressively more difficult to drain groundwater to facilitate mining activity.

The expense of the extractive effort of mining must have approached exponential rates as depth increased; a situation increasingly inevitable in the infrastructure-hungry, better-governed societies, with surface resources becoming depleted as populations teemed.[132]

3.3.2.2 Watt files a specification

In the interim Savery and Newcomen had reached an agreement around the patent matters between them and the patent was to last for some thirty-five years. The relative inefficiency of this enormous device was absorbable so long as there was a proximate supply of coal but became intolerable in the more inaccessible tin and copper mines of Cornwall. Spear recounts that despite this inefficiency there were approximately 300 Newcomen engines *in situ* by 1780, itself a testament to the rapid advancement of mining activities.[133]

James Watt was elected a Fellow of the Royal Society in 1785. He was also a member of the Lunar Society (below). His importance lay in his applying a separate condenser to the Newcomen engine thereby greatly improving its efficiency. He had received his patent (granted 5 January) in 1769.[134] After earlier financial support from chemist John Roebuck and advice from entrepreneur Dr. William Small, Watt filed a specification for his 'invention' which covered the general principles only. This step was by now an increasingly demanded aspect of the grant process. Thereupon, there was a hiatus occasioned by Roebuck's 1773 bankruptcy, which led to Watt forming an alternative partnership with Matthew Boulton an individual possessing of such acute business acumen that he was proprietor of the world-famous Soho Engineering works in Birmingham. Boulton saw the potential in Watt's application of steam to the extent that, with time

[132] By 1700, London had a population of over half a million inhabitants; throughout England, Wales and Scotland there were seven million people. By 1801, London sustained 864,000 residents.
[133] Spear, p. 54.
[134] GB 913 [1769].

running out to recoup his opportunistic investment, he adroitly paid for a Private Bill through Parliament in 1775 which extended the term for 25 years.[135] Boulton had form in avoiding premature disclosure. In correspondence with Aimé Argand he commended the lamp inventor for avoiding 'mechanical minutiae'[136] after the Swiss chemist feared of 'giving particular description…confining ourselves to these particular forms and enabling others to use the same principle under other forms.'[137]

One has to at least consider that the investment was as much opportunistic *re* the possibilities presented by another vacuum; this one being the absence of detail in Watt's construct of a specification. Although seven decades post the Savery demonstration and grant, this specification for steam conservation condensed its very own fog without much difficulty. There was little *measurable* disclosure. The fourth principle, in describing an intention *in many cases* to employ …steam…to press on the pistons*, 'or whatever may be used instead of them'* remains a marvel of paranoid vagueness. Disclosure to a reader as a potential future rival was anathema. One response showed that scientific principles need not be roadblocks. Rather than wait for the prize of his freedom to operate a partly-written secret, Richard Trevithick (in tandem with Davies Gilbert, a future Royal Society president) pursued alternative routes and prevailed with his design-around by making a condenser-free engine.[138] Nevertheless, as an example of investor shrewdness, the tale above is but one example of the influence so exerted by Boulton.[139] Although assumed to be unskilled in business, showing a want of Boulton's canniness, Watt's reticence was more of the subtle variety, submitting that inventor security could be reinforced by stalling public disclosure of the specification until patent expiry.[140] Quite reasonably however, his concern was that specifications allowed anyone prepared to pay a small fee unfair access to technical

[135] Public Act, 15 Geo. III. c. 61 (1775). 'An Act for vesting in James Watt…the sole Use & Property of certain Steam Engines…of his Invention,…throughout His Majesty's Dominions for a limited Time.'
[136] Boulton to Argand, 31 July, 1784, Assay Office Library, Birmingham.
[137] *Ibid*., Argand to Boulton, 4 July, 1784.
[138] Selgin, G. Turner, J. L. Strong Steam, Weak Patents, or, The Myth of Watt's Innovation-Blocking Monopoly, Exploded, *Journal of Law and Economics*, 54, 4, 2011, pp. 841-61 at 852-53.
[139] Birmingham was now one of the main expanding urban centres.
[140] Robinson, E. James Watt and the law of patents, *Technology and Culture*, 13, 2, 1972, pp. 115-39 at 130 citing: Watt, J. Boulton and Watt MSS (Watt to Boulton) *Thoughts upon Patents for exclusive Privileges for New Inventions*, Box 21, Birmingham Reference Library, 21 July 1785.

knowledge and thus undeserved advantage and potentially even anticipation of an invention.[141]

3.3.2.3 The Lunatics take charge

It was simply not sustainable for the new cities of England to attempt to compete with the capital and a learned grouping with the cumulative intellectual calibre of the Royal Society. Rather what they could do was to complement what was happening, all to the benefit of their own urban potential. So in the so-called 'factory towns' there emerged, from the seed of the schools set up to educate the Nonconformist ministers of the Dissenting sects, the *de facto* Dissenting academies. Foremost among these was the Lunar Society (c. 1765-91) of Birmingham. Their inception was required as the Quakers, Baptists and Methodists found their route to conventional university admission cut off.

Aside from Boulton and Watt, others were similarly possessed of a profound practical bent coupled with curiosity and, for some of them, entrepreneurial zeal. In this they were different from the earlier London-based Learned Society in that the latter were altogether more blue-skies in their fundamentalist type approach, with a significant focus on mathematics and astronomy, as compared to the distinctly applied nature of the Lunatics, as they were sometimes called. A selection of the main personalities and a partial description of their attributes is summarised in Table 2.1.

[141] Robinson (1972) p. 130.

Table 3.1

A selection of members of the Lunar Academy[142]

Member	Lifetime	Interests
Matthew Boulton	1728-1809	Manufacture of metal products
Erasmus Darwin	1731-1802	Physician, grandfather of Charles Darwin
Richard Lovell Edgeworth	1744-1817	Inventor, educationalist, agronomy
Samuel Galton Jr.	1753-1832	Quaker gun manufacturer, scientist
James Keir	1735-1820	Chemist, mine operator
William Murdoch	1754-1839	Inventor of the gaslight, Scottish engineer, Worked for Boulton and Watt in the Cornish mines
Joseph Priestley	1733-1804	Unitarian clergyman, electrochemist
William Small	1734-1775	Physician, metallurgist, teacher of Thomas Jefferson
James Watt	1736-1819	Inventor, engineer, chemist
Josiah Wedgwood	1730-1795	Potter, chemist, also grandfather of Darwin

3.3.2.4 Openness and secrecy collide again

The general perspective of these innovators was to harness the continuum that it is the natural world. As Uglow has summarised:

> '[*T*]*hey knew that knowledge was provisional, but they also understood that it brought power, and believed that that this power should belong to us all.* '[143]

This philosophy was not always compatible with the vagaries and ambitions of human nature, both in terms of self valediction through promotion, the necessity to make new contacts to secure future business and on the other, the impulse to copy. In 1784 Wedgwood was introduced by Boulton to a Danish businessman recently domiciled in Birmingham, the ambition of whom was to sequester information for his own government. Upon examination of his bags prior to departure after a five-year sojourn, the discovery of a raft of graphics of clays, tools, machines and

[142] This is an abbreviated list, adapted (in-part) from: Schofield, R. E. The Industrial Orientation of Science in the Lunar Society of Birmingham, *Isis*, 1957, 48, 4, pp. 408-15.
[143] Uglow, J. *The Lunar Men*, London: Faber & Faber, 2002, p. 501.

interestingly, models was made and he was apprehended. His embassy willingly handed over bail of £300 to secure his release and presumably his embedded knowledge.[144]

A similar episode also involving Boulton resulted in this regret:

'*If I have anything to reproach myself of in my conduct towards strangers it is in haveing been too liberal & too unguarded in showing those things which my duty to my Country & to my self required more reservation in.* '[145]

It is illuminating to consider the perspective of both sides in terms of patriotic duty rather than naked self-interest; but also the divide between England's once-successful, historical policy of inviting an artisan from abroad so as to trade his private, unwritten latent knowledge, in exchange for letters patent and a period of exclusivity, with a simple theft of ideas.[146]

3.3.3 The scientific experiment as visual communication

3.3.3.1 Epistemological advancement at the gates

One immediate difference between Robert Boyle and members of the Lunar Society would have been the former's proclivity for disseminating the results of his work. While frustrated at the haemorrhage of time occasioned by callers to his home; he was accepting of these constraints, amongst which required him to accommodate those who might have expressed a curiosity about his activities. He had, in permitting sight of his 'processes' promoted access and condemned 'unwarranted secrecy' and decried 'intellectual unsociability'.[147] Boyle was perhaps aware that he was working at the cusp of a new order, namely that of a

[144] Uglow (2002) p 397.
[145] *Ibid.*, p 399.
[146] Home-grown espionage was also problematic; James Watt Jr. had cause to investigate an employee of the Soho works who had made drawings of engines and machinery. Aplin, T. Bently, L. Johnson, P. & Malynicz, S. *Gurry on Breach of Confidence: The Protection of Confidential Information* 2nd edn. Oxford: University Press, 2012 (original edn. published 1984) pp. 20-21.
[147] Shapin, p. 385 citing: Boyle, R. 'An Epistolical Discourse of Philaretus to Empiricus…inviting All True Lovers of Vertue and Mankind, to a Free and Generous Communication of Their Secrets and Receits in Physick' (prob. written 1647), in Hartlib, comp., *Chymical, Medicinal, and Chyrurgical Addresses* (cit. n. 10), pp. 113-50, rpt. In Margaret E. Rowbottom, "The Earliest Published Writing of Robert Boyle," *Annals of Science*, 1948-1950, 6: pp. 376-89 at 380-85.

physicochemical Enlightenment through which he was cross-examining the natural world in the quest for explanations.

But he was attempting to do this in a partial void which had not yet cultivated a *lingua franca*. As Shapin describes it, in the mid-to-late seventeenth century, there was a linguistic distinction in England between 'trying' an experiment, 'showing' it and 'discoursing' upon it. In finding purchase for this concept he suggests that *trying* corresponds to research proper, replete with the uncertainty this entails, *showing* is the demonstration of the working experiment, with a *discourse* being '*the range of expatiatory and interpretative verbal behaviours that either accompany experimental shows or refer to shows or trials done at some other time or place.'*[148] This then was the new mean free path for science.

First-pass experimental fine-tuning was often conducted in the privacy of the experimentalist's home before being presented to a sceptical, rigorous, yet open audience in a public forum such as that of the Royal Society. To cement the point, one must take cognisance of the fact that *de novo* practitioners from the Society, were seeking to answer some very fundamental questions in and about media which had never been so cross-examined before.[149] Some disciplines were inevitably constrained by inherent complexity. For example, that founder of the Society who was a physician, Francis Glisson (1597-1677) who had authored the first treatise on rickets, soon after, prompted by Harvey's discoveries, hypothesised on the concept of biological irritability.[150] Although an effusive author and illustrator of his anatomically important experiments, it was all of a century before the requisite experimental correlations were concluded and published by von Haller. Even then the causes remained beyond knowing; until knowledge permitted,[151] in the manner of Newton, it had to remain adequate to study the effects.[152]

Consequently, there is no surprise in reconciling this position with the (for the most part) absence of requirements for filing of specifications by those (few as

[148] Shapin, p. 400.
[149] Kuhn, T. S. Mathematical versus Experimental Traditions in the Development of Physical Science in: *The Essential Tension: Selected Studies in Scientific Tradition and Change,* Chicago: University Press, 1977, pp. 31-65 at 43.
[150] Glisson, F. *Anatomia hepatis*, London: 1654.
[151] In this case the absence of the microscope and knowledge of organic chemistry.
[152] Porter, p. 250.

yet) innovators seeking to protect their inventions *via* the route of letters patent. So, it is argued here that the genesis of the patent specification, linked as it is historically to a patchwork of early requests from Law Officers and the later arguments of Lord Mansfield in the following century, correlates, indeed depended upon, a trailblazer such as Boyle to provide the epistemological and linguistic framework for how a scaffold of observation might define the success or otherwise, of a hypothesis.[153] This exposure to potential public fallibility would have been a step too far for the Lunatics.

According to Sir Joshua Reynolds, creativity:

'*consists in forming new combinations of images and ideas previously gathered and deposited in memory. Nothing can come of nothing: so if we have laid up no raw materials, we can produce no new combinations.'*[154]

It strikes that an ever increasing dissemination of material recorded as written papers, pamphlets, and books, facilitated an availability of material critical to accelerate the upload to the body politic of intellectual storage, necessary prompts for future technological and sociological advancement. The accumulation of these materials has enabled society to fine-tune its creative faculties by: drawing on self-experiences; by interrogating media stored in libraries or equivalent repositories; by observing events bearing upon the general field of a problem; highlighting awareness of the activities of peers and how they have resolved similar challenges; by conducting experiments designed to provide answer(s) to questions posed by a challenge or hypothesis; by observation and rigorous assessment of the outcomes of such experiments so as to sustain or deny the hypothesis or restate the problem at hand.[155] These steps can be informed by intuition and creativity but they must ultimately yield to an answer.[156]

The scientific method as deployed by Boyle *et al*. might be termed a particularly potent expression of creative thought. Calling it a method represents an

[153] In this Boyle was continuing a tradition started by Gilbert.
[154] Founder of the Royal Academy.
[155] Killeffer, D. H. *How did you think of that?* Washington: American Chemical Society, 1973 (chapter 1) describes the utility of the scientific method.
[156] As noted by Reville: '[*T*]*his hypothesis, which must be refutable, is used to make a prediction about the phenomenon, which is then tested by experiment. If the experimental results support the hypothesis, further tests are devised. If all tests continue to support the hypothesis, confidence in the hypothesis grows and eventually the hypothesis is elevated to the status of a theory-science's best explanation.'* Reville, W. Scientific method is fantastic, but fallible, *The Irish Times,* August 15, 2013 p. 10.

understatement, for what the Lunar Society was attempting was a practical interrogation with a rather more limited, but potentially more lucrative, horizon. The exponents of how the natural world should be questioned were present at the genesis of the scientific method; the luminaries of the Lunar Society entered a little later in this newly evolving paradigm and though susceptible to risk of failure and financial loss, were able to provide a practical problem, and recognise early on whether the derived solution had an immediate and realisable utility. It might reasonably be argued that such 'success' was confirmation of the completeness and accuracy of the starting hypothesis. This is the essence of the boundary between the utility of a patentable solution to a problem, later underwritten by its written description, and the excluded categories of inventions or discoveries which are inextricably linked to the laws of nature.

3.3.3.2 Lingua Chimica

Nef argued for recognition of the long-drawn out nature (from the sixteenth century) of the rise of industrialism leading to the 'Industrial Revolution'.[157] Irrespective of the stimulus from capital and the need to compensate for the absence of the power available from fast-flowing rivers in England, there was also the matter of the *later* hand-holding between the unlettered empiricists and the applied technologists.[158] In one compilation, there has been confirmation that each of these siblings, of necessity and as predicted by Bacon, evolved creative adaptations of older skills.[159] Already possessing a high degree of literacy, the Quakers (in recognition of their earlier persecutions) also added their proclivity to insist on a thorough record-keeping of all activities. Distrustful of physics, philosophy and the classics, their preferred vocational outlets were the inner-lights of navigation, arithmetic, geometry, husbandry and medicine; but especially blessed was chemistry.[160]

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[157] Nef, p. 22-24.
[158] Musson, A. E. Robinson, E. *Science and Technology in the Industrial Revolution*, Manchester: University Press, 1969, pp. vii, 21, 27-29.
[159] Pratt, D. H. Empirical Education and Quaker Prowess in Chemically Oriented Businesses during the Industrial Revolution, *Journal of Educational Administration and History*, 12, 2, 1980, pp. 7-18 at 7.
[160] Pratt, pp. 8-9.

Something less tangible yet more enduring, now arose. Antoine Lavoisier (1743-94) may have plagiarised Priestley,[161] the chemist, Dissenting theologian, political thinker and arch-science communicator[162] of the Enlightenment,[163] but he possessed a uniquely questioning mind, re-arranged facts and introduced, *à la* Newton for physics, measurement into the comprehension of chemical phenomena. In pioneering his concept that the names of substances then in use bore but abject correlation with their chemical composition and building on the principles of Boyle, he defined both of element and compound. In drafting the first table of chemical elements, he thus confirmed the demise of alchemists.[164] In this he modernised accountability in science through his tenet that language must be a fundamental tool of analysis, ultimately providing a validation of the concluding transformations being wrought by a scientific discipline on society's historical stagnation where 'all advances in science were proscribed as innovations'.[165] The properties of manufactures could now be more confidently described[166] *via* a patent specification.

Quaker chemist and one-time classmate of Darby and later a mathematics teacher at the Dissenting Academy in Manchester, John Dalton (1766-1844) after experimenting with gases, next formulated the idea of chemical elements being made up of atoms, each characterised by their own, distinct atomic weight. The outcome (even though Mendeleyev's periodic table did not emerge until 1869) was that atomic theory founded on a precise, mathematical basis had now been laid down for chemistry. An accuracy of materials description was close to hand yet despite the irrevocable redundancy and demise of the alchemists the study of matter remained a problem child. An 1825 description by surgeon Walter Weldon noted that participation required time, premises, expensive and sensitive instrumentation,

[161] Toulmin, S. E. Crucial Experiments: Priestley and Lavoisier, *Journal of the History of Ideas*, 18, 2, 1957, pp. 205-20 at 207.
[162] A polymath who also mastered six ancient and three modern languages.
[163] His role in the 'development of science as part of the public culture was fundamental.' Ceci, C. Joseph Priestley, Champion of enlightenment in science and education, *Royal Society of Chemistry News*, April, 2013, pp. 8-9.
[164] Lavoisier, A. L. *Traité de Chimie* (Elements of Chemistry in a New and Systematic Order containing all the modern discoveries), Paris: Chez Cuchet, 1789, Edinburgh: 1790.
[165] Thomas Jefferson, letter to Priestley, 21 Mar. 1801.
[166] Lavoisier, A. L. Réflexion sur le Phlogistique (Reflections on Phlogiston), *Oeuvres*, 2, 1785, pp. 623-55.

manual dexterity, thought and attention, for its successful prosecution;[167] the only one of these attributes removed from a reliance on written exposition of the science being arguably that of finance. Indeed Dalton's publication by the Royal Society [168] of his efforts on atmospheric composition noted they had taken him forty years of experimentation and even then had been pre-empted by Sir John Herschel becoming the first to publish an atomic view of acidic salts seven years earlier in Edinburgh. Being the first to 'invent' had a clear dividend for the prospective patentee but a focussed mindset reaped reward too for the first experimental philosopher in a scientific discipline to disseminate their written description.

3.4 The patent specification as a full description

3.4.1 Preparing the ground for the Common Law

3.4.1.1 Fever in the Privy Council

An episode relating to what might at best be termed misplaced optimism was occasioned by Dr. Robert James (1703-76) in 1752. An action involving this practitioner's fever-cure patent seems to have been the last to be handled by the Privy Council.[169] This body, especially under the rule of Elizabeth and Charles I had provided a form of rapid-response oversight on a streamlined basis for the purposes of regulating industry and commerce. Since William and Mary, Parliament was now much more to the forefront. Yet in a reminder of the unsuitability of matters prerogative for such matters James was created doctor of medicine at Cambridge in 1728 by royal mandate rather than the conventional route of qualified student.[170] Whatever the merits of his progression (he was admitted as a licentiate of the College of Physicians in 1765) from the perspective of the subject of this research, he was a considerable author, yet most damagingly, he

[167] Golinski, J. *Science as Public Culture: Chemistry and Enlightenment in Britain, 1760-1820,* Cambridge: University Press, 1999, pp. 260-61.
[168] Dalton, J. Sequel to an Essay on the Constitution of the Atmosphere, *Philosophical Transactions*, 127, 1837, pp. 347-63.
[169] Hulme, E. W. Privy Council Law, Part II, pp. 193-94.
[170] Munk, W. *The Roll of the Royal College of Physicians of London, Vol. II*, 2nd edn. London: 1878, p. 269.

took the unorthodox, yet not unique route of patenting his 'secret' remedy yet falsified the specification with catastrophic consequences (below).

Meanwhile, because of the nature and size of the Commons, meetings' frequency and attention to specific detail were of necessity diluted. So while in theory the Statute of Monopolies had represented the high-water mark for some two decades of a struggle between the Commons and the monarch,[171] providing as it did in Section 2, that monopolies should be '*examined, heard, tried, and determined in the courts of common law*'; notwithstanding this stipulation, the Council retained its oversight on matters patent for many more decades.[172] Of course, previous to this any instance of usurpation of royal authority was to be discharged through the Court of Star Chamber but this authority was later quenched.[173]

Yet, Fox noted that after the passage of the Statute, only one case is reported in the common law courts during the seventeenth century and one in the first half of the eighteenth century.[174] Patent law litigation was still a minority pursuit, for it was not until 1693 that *Edgebury* v *Stephens*[175] became the first case to deal with a patent for invention. Subsequent to *Dollond's Case*[176] which was heard in the Court of Common Pleas in 1766, there were twenty-one cases heard during the second half of that century.[177] The proportion of patents litigated between 1714 and 1758 in the Court of Chancery was approximately 5%. Bottomley has highlighted that as revocation was not an applicable endpoint at

[171] According to one commentator however it merely enacted: 'an existing state of affairs in the Common Law.' Kyle, C. R. 'But a New Button to an Old Coat': The Enactment of the Statute of Monopolies, 21 James I cap.3, *Journal of Legal History*, 19, 3, pp. 203-23 at 217.
[172] Fox, pp. 118-19.

[173] The Star Chamber continued to claim jurisdiction in matters concerning the royal prerogative including letters patent authorised by proclamation. The writing was on the wall however when an order-in-council of March 31, and a proclamation of April 9, 1639, revoking a large number of monopolies, failed to quell ongoing anger at both monopolies and the '*exercise of jurisdiction concerning their enforcement by the Council and its Court of Star Chamber.*' The outcome was the abolition of the Court by the Long Parliament on July 5, 1641. Fox, p. 124.
[174] Recent research has unearthed a minimum of forty-one bills of patent being pleaded in the Court of Chancery in the first half of the eighteenth century. The inference arises then that a more accurate break-line for the Privy Council turning away from its patent jurisdiction was not from 1753 (Dr James' case, following) but perhaps post the Glorious Revolution of 1688. Bottomley, S. Patent Cases in the Court of Chancery, 1714-58, *Journal of Legal History*, 35, 1, pp. 27-43 at 31, 36. However, see Dollond's case (next).
[175] 1 Web Pat Cas 35; 90 ER 1162; 91 ER 387; 1 HPC 117; 2 Salk 447.
[176] (1766) Dollond's patent: GB 721[1758]: *Dollond* v *Champneys* tried in Court of Common Pleas, 1 Web Pat Cas 43.
[177] Fox, p. 119.

equity, these proceedings were most likely to have been instigated by the holders of the litigated patents.[178] This informs albeit indirectly, that these contested/contravened awards were most unlikely to have been in court on the basis of the authors' written descriptions for each, but rather sought satisfaction, presumably in the form of injunction, 'in accordance with a settled pattern of equitable practice.'[179]

3.4.1.2 Newton is overruled: -the written description comes into focus

Another legacy of Dollond's patent lies in the preliminaries before his 1758 grant. For, he too had chosen the medium of a letter to *Philosophical Transactions*, where, he reviewed strategies for eliminating optical aberration. In preliminaries he outlined his improvement in the form of a tantalising challenge for rivals vending five-glass telescopes: 'such persons, as are the best judges, to be a considerable improvement on the former.'[180] He then cogently described and even advertised his advance of incorporating a sixth glass; noting how these were well received in 'foreign parts'. The conclusion respectfully noted that the addressee (Mr. James Short, FRS) was not unacquainted with the theory outlined, concluding: 'much as the subject has never been fully treated by any author, I shall endeavour, as soon as may be, to draw up a more particular explanation…but shall add no more at present…'[181] In essence the technology had never been adequately described in public.

Dollond's patent was granted five years later. It has been suggested that the patentee was self-restrained through his knowledge of already extant achromatic lenses, in not pursuing contemnors.[182] However, from the tone of the letter, there is a sense of self-valediction through a preliminary exposure of the challenge and the brevity of a published, competitive scientific response. Whether foolhardy or not this bravura exposition drew a significant riposte. Dollond's patent[183] commenced 19 April 1758 one week after he had, under the Royal Sign Manual, been invited to

[178] Bottomley, S. Patent Cases in the Court of Chancery, 1714-58, op. cit., p. 34-36.
[179] *Ibid.* Bottomley's methodical analysis hints at a strong proclivity among patentees for this route.
[180] Dollond, J. Concerning an Improvement of refracting Telescopes, *Philosophical Transactions,* Read 1 March, 1753, pp. 103-07 at 106.
[181] *Ibid.*, p. 107.
[182] Hulme, Privy Council Law, Part II, p. 191.
[183] GB 721 [1758].

'[*C*]*ause a particular Description of the nature of his said Invention by writing under his hand and seal to be Inrolled in Your High Court of Chancery otherwise Your said Grant to be void…*'[184]. This was qualified by the adjunct that the privilege was annulled if the applicant was found to '[*I*]*mitate any Invention or work whatsoever which hath heretofore been found out or Invented by any other of our Subjects… and publickly used or exercised…in our…Kingdom…*'[185] Soon after the Royal Society was treated to an award-winning paper[186] on the invention,[187] read 8 June 1758. Unfortunately for his legacy, Dollond, while citing Newton, had omitted to credit Samuel Klingenstierna the Swedish mathematician and natural philosopher.[188] Dollond's correction of telescope aberration had been '…extolled in principle in the patent specification but left unelaborated…'[189] Subsequent correspondence contained derision for the patentee as behaving in a manner unworthy of a scientist: 'this Artifice was necessary to you, in order to attribute to yourself my whole discovery....'[190] The affair affords an early demonstration that, ethical positions aside, those operating in a technological sphere needed to be less reliant on personal relations and apprise themselves of each of (international) patent enrolments *and* current proceedings in the emerging literature.

Further activity for the patent concluded with his son's later victory (after a 1764 application for vacation before the Privy Council) over 35 instrument-makers. Such a substantial cohort possibly felt secure in that there were rival, earlier inventor(s). Yet crucially, despite question marks over sufficiency and priority, Dollond (jnr.) prevailed, for the rivals' status was not obstructed for want of the patent being taken 'beyond the laboratory.'[191] Newton's fourth rule had asserted '…we are to look upon propositions inferred by general induction from phenomena as…very nearly true…till such time as other phenomena occur by which they may

[184] King's bill (retained in the Signet Office as warrant; TNA SO 7/233). See Gee, B. *Francis Watkins and the Dollond Telescope Patent Controversy,* McConnell, A. Morrison-Low, A. D. (eds. *Science, Technology, and Culture*) Farnham, Surrey: Ashgate, 2014, pp. 325-30.
[185] *Ibid*., p. 328.
[186] Dollond, J. An Account of Some experiments concerning the different Refrangibility of Light, *Philosophical Transactions*, 50, 1757, p. 733-43.
[187] Awarded the Copley medal.
[188] Klingenstierna thus highlighted errors in Newton's method.
[189] Gee, p. 126.
[190] See: Gee *op. cit*., pp. 335-38 for excerpts of this correspondence from Nordenmark, N. V. E. Nordström, J. Om uppfinningen av den akromatiska och aplanatiska linsen, *Lychnos*, 5, 1939, pp. 313-84.
[191] MacLeod, p. 70.

either be made more accurate or liable to exceptions.'[192] Yet this stalwart of the scientific method, rooted in the empiricism of observation, now presented as an internalised laboratory logbook, was deemed deficient before the courts. The true record for a patent of invention could only be the published, written description.

3.4.1.3 A correlation of composition with proof-of-principle

Authored by D. Ryder and W. Murray, and published in 1754, there was a submission that the proceedings concerning James' medicament were essentially null and void as the patent had been granted for a powder and pill whereas the complainants could only claim association with a powder. The December 9th 1752 plea by a chemist, reads:

> '[T]he *affidavits ... of Walter Baker, ...to vacate the patent ...for Schwanberg's powder, for Curing Acute and Inflammatory Fevers, &c. and also his Aurum Horizontale Pill, For Curing and Relieving Chronic Cases, Both Invented and Published many Years before the said Dr. James obtained the said Letters Patent: With a copy of the report, upon the hearing before the Attorney and Solicitor General…. Also The Masked Specification of Dr. Robert James, Inrolled in Chancery… Now lying in the Office of His Majesty's most Hon^ble^ Privy Council: for which A Bill of Indictment for Perjury has been Preferred….*'

Whatever about the merits or deficits of patentability, novelty and inventive step, the sufficiency of disclosure on this occasion was dealt with *via* a comparison of the method and composition of the respective claimed medicinal preparations. Particularly chilling is the later comment that:

> '*…we are indebted for the following account of the famous (alias infamous) nostrum, which has been industriously advertised in this country,…under the name of Dr. James's fever-powder, a medicine, which in some cases …has been administered with advantage, but in typhus fever,*

[192] Strong, E. W. Newton's Mathematical Way, *Journal of the History of Ideas*, 1951, 12, pp. 90-110 at 94.

and putrid sore throat, as Dr. Munro observes, has hastened many thousands to their graves.'[193]

The remark is less than surprising as the formulation contained antimony and mercury, each now known to be considerable toxins. With the increase in availability in medicines and the fracture of the link between preparation, supply and administration, there was now an onus to protect the public from unknown, if not less-than-understood products. Such oversight needed to be bolstered with the memory of trustworthy disclosure and complete description. Raising objections James fought to the end and beyond. A posthumous publication of protest emerged two years after his death.[194] Regulation was to take some time to catch up with this new reality but there was awareness that where composition correlated with physical, chemical or biological property, either or both of fraud and error were probable, unless a demand for an adequate description was forthcoming. In a pattern that has necessarily continued ever since, published pharmacopoeial standards needed science to help them respond by delineating the emerging narrative of an eclectic array of drugs. It would be a small step to seek similar depositions from a patent applicant.[195]

3.4.2 The specification is set in cement

3.4.2.1 Knowledge becomes etched

The James affair highlighted the ongoing dilute authority associated with a written description for a claimed invention. The irony is that it was not ink but the development of a corrosive agent for scoring a working surface or substrate which helped to bring this unsatisfactory state of affairs to its logical conclusion. Early indicators of the clamour to access potential benefits of enhanced chemical proficiency (as later applied by the Quaker fraternity) are indicated by a 1637 grant

[193] Reece, R. *Monthly Gazette of Health*: London: Sherwood, Jones & Co. Vol. VIII, 1823, pp. 745-47.
[194] James, R. *A Vindication of the fever Powder, and a short Treatise on the Disorders of Children*, London: 1778.
[195] A particularly comprehensive description shortly emerged: Pearson, G. Banks, Sir J. Experiments and Observations to Investigate the Composition of James's Powder, *Philosophical Transactions*, 81, 1791, pp. 317-67.

in favour of the transmutational efforts of Captain Thomas Whitmore.[196] This was not an isolated, spontaneous interest for an everyday product. It bore an indelible relationship with the earlier, ostensible wish of lord treasurer William Cecil to facilitate an independent military capability to the extent that he and others of the 'Society of the New Art' received letters patent in 1575 to use 'vitriol' for transmutation.[197] The preamble to this grant contained a nugget of information transfer that they:

> '*myndynge, as behoveth so good and excellent an Invention so hardly and so happelye come to, to farther and advaunce the skilfull first fynder thereof graciously to reward, as to us in honour in such cases doth appertayne, do therefore, to contynue the memory of the same Invention and of our gracious acceptynge thereof*'.[198]

If syndicates were now to start displacing the utility potentially derived from the individual inventor's efforts the pressure to secure a regularised benefit would ultimately require the submission of a written disclosure. This would be difficult for transmutative processes which defied full understanding; perhaps not really an acute inconvenience for these well-connected concessionaires. Later Bacon included his observations on this 'oil' in a section of the *Instauratio Magna* devoted to experiments. The substrate for these efforts, oil of vitriol (now sulphuric acid) was first used as an apothecaries' *nostrum* but later, in a non-pharmaceutical guise, became, through its link with cotton, a key facilitator of the Industrial Revolution.

Joshua Ward (1685-1761) on returning from exile in France established, with a John White, the first functional English plant for vitriol manufacture in 1736. This used expensive glass vessels. Success obliterated importation and ready access caused the price to fall massively; they relocated and received a patent in 1749.[199] Key customers were the haberdashery-related trades and the chemists.

Vitriol's use became substantially one related to bleaching. The role of gatekeeper for the transition from mystical alchemy to industrial chemistry is attributed to Johann Rudolph Glauber (1604-70).[200] Based on his own laboratory

[196] GB 108 [1637].
[197] Hulme (1900) pp. 46-47.
[198] Cunningham, p. 58.
[199] GB 644 [1749].
[200] Glauber, J. R. *Novum lumen chemicum*, Amsterdam: 1664.

efforts, this German-Dutch chemist's output features substantial experimentation on processes of decomposition.[201] Drawing on the English edition, John Roebuck (1718-94 also a physician and strict Dissenter) had experimented with sulphuric acid and he recommended it to acquaintances as a replacement for acid derived from sour milk and ashes.[202] Roebuck however next established his own vitriol works in Scotland (also in 1749) using Glauber's observation that lead was not attacked by this agent. While Scotland had attractions concerning linen, there may have been another enticement. Experiments using vitriol were also conducted there by physician Francis Home. Home's published reports specified proportions, quantities and observations. His approach to the process of experiment was expert, organized and individually concise. However, the reading audience remained unimpressed. A contemporaneous review informs much better about the expectations from written descriptions and the relative immaturity of the state of writing on experimental technology. From these annals of literary critique were noted the absence from Home's writing of a 'pause for recollection; no mark of distinction for the memory.' The sense of drudgery of presentation provoked a paean '[S]urely there is a less unpalatable way of communicating natural knowledge.'[203] There is a sense of a threshold, especially for emerging processes, about these comments; a formalized clarity was becoming essential for effective passage of technological progressions. Yet until the later introduction of the newly annunciated arrangements by Lavoisier and Dalton, the description of *materials* remained outside the orderly abode, indeed presence, of the physical models expected from engineering inventions.

In the meantime, although initially successful in its control, Roebuck's Prestonpans plant, complete with high walls to maintain secrecy, could not avoid the haemorrhage of information from bribed workers.[204] He and business partner Samuel Garbett were obliged to seek the security of a patent.[205] On challenge,[206]

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[201] *See*: Glauber, J. R. (IV Of the Preparation of the Fire of Vitriol) *The First Century, Glauber's Wealthy Store-house of Treasures*, trans. Packe, C. London: 1689.
[202] Jardine R. An Account of Dr. John Roebuck MD FRS Edinburgh, *The Edinburgh Magazine*, November, 1798, pp. 332-37 at 332. Also: *Transactions of the Royal Society of Edinburgh*, 1796, 4, pp. 65-87.
[203] Anon. *Experiments on Bleaching* by Francis Home, *The Critical Review*, or *Annals of Literature*, 1, March, 1756, pp. 106-14 at 114.
[204] Clow, A. Clow, N. L. Vitriol in the Industrial Revolution, *Economic History Review*, 15, 1 & 2, 1945, pp. 44-55 at 46.
[205] 1771, 9 August, *Specifications of Patents and Drawings*, 1767-87.

the Scottish courts decided the patent was bad; although not published *per se*, the technology had by now been practiced for two decades in England. The venture capitalist community can only have been warned of the likely folly of seeking to maintain a tight seal around secret knowhow when the increasing 'tempo in textile production put considerable pressure on cloth finishers to accelerate their processes.'[207] The safe haven of a patent, even at the risk of disclosing key information, must increasingly have etched into the forefront of their consideration.

That this was an increasingly prevalent consideration is exemplified by another use for this versatile reagent. The combination of design, chemistry and engineering now resulted in a heretofore unrealised complexity for the mechanical workshop. Elaborate descriptions supplied by apothecaries and stationers appeared for new machines for varying the colourings and staining of papers-hangings, calicoes and fabrics.[208] Many of the offerings were founded on the description of technique contained in a much sought after compendium replete with technical directions for realizing colours, effects and finish.[209] Some using 'oyl and vitriol' now emerged as patents were awarded for offerings seeking to satisfy some of the less sober aspects of life. That awarded to Jacob Bunnett covered a machine, describing, with the aid of figures, the location, gearing-mechanism and processes of use for cylinders, rollers and brushes to dispense colour.[210] Ironically while technological combinations continue to cause difficulty for patent examiners today, nevertheless the zeal of competition during the eighteenth century meant that the security conferred by a patent was becoming ever more attractive. This realisation was coincident with a newly exalted position for English decorative paper with burgeoning demand from France and America.

3.4.2.2 Hard information

The contexts for the demands of adequate descriptions by Lord Mansfield are now apparent but this stipulation, from the courts did not transpose into a coherent

[206] *Roebuck & Garbett* v *Stirling & Stirling*, Session Papers, F. 166: 18.
[207] Clow & Clow, p. 48.
[208] Sugden, A. V. Edmondson, J. L. *A History of English Wallpaper 1509-1914*, London: B. T. Batsford, 1925, p. 115.
[209] Dossie, R. *The Handmaid to the Arts*, London: J. Nourse, 1758.
[210] GB 1540 [1786].

obligation[211] to so provide until the 1852 Act.[212] The subsequent *Liardet* case had been signposted. For the 1753 dispute between Lord Mansfield and the Privy Council over the petition to revoke Dr James' 1747 patent, Davenport has recorded comments that (thereafter) 'the Council compelled patentees to take the common law remedy if their patents were infringed.'[213]

In 1773 John Liardet was granted a patent for 'Cement for building purposes.'[214] Five years later, before the King's Bench, this was to feature in possibly the premier patent law case of the eighteenth century.[215] The relevance of the case to this chapter resides in the latent requirement for the communication of a more detailed disclosure. Lord Mansfield (Earl of Mansfield, 1705-1793) handed down that:

> '*the law requires as the price the patentee must pay to the public for his monopoly that he should, to the very best of his knowledge, give the fullest and most sufficient description of all the particulars on which the effect depends.'* [216]

In an instruction to the jurors that if they were to find for the patent owner, they must be satisfied that the specification contained a sufficiency of information that those others following be able to prepare the composition: he maintained,

> [*T*]*he meaning of the Specification is that others may be taught to do a thing for which the patent is granted, & if the Specification* [is] *false, the patent is void, for the meaning of the Specification is that after the term* [of the Patent] *the public shall have the benefit of the discovery.'*[217]

There remains some reticence on the part of commentators to accepting that these words represent a pivotal moment in patent jurisprudence with a relatively recent

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[211] Although a vehicle for temporary reform the justification for this position is that the plethoras of reforming (rights of inventors) committees, some in existence for nigh on six decades, were almost immediately wound up. Still primarily a system of registration, the Law Officers now had responsibility for the Patent Office. The Comptroller was to ascertain whether the specification constituted an accurate description of the invention.

[212] Patent Law Amendment Act of 1852, 15 & 16 Vic. C. 83 (Petition and declaration to be accompanied with a provisional specification; s. 6; also s. 8, s. 9, s. 13).

[213] Davenport, N. *The United Kingdom Patent System, a Brief History*, Hampshire: Kenneth Mason, 1979. p. 72.

[214] Liardet's patent 3 April, GB 1040 [1773].

[215] *Liardet* v *Johnson* (1778) Bull NP 76; 1 Web Pat Cas 53; 1 Carp Pat Cas 35.

[216] Van Dulken, S. *British Patents of Invention, a Guide for Researchers*, London: The British Library, 1999, p. 62.

[217] Extracted from: Aplin, T. *et al*, p. 26 citing: Oldham, J. and Mansfield, W. M. *The Mansfield Manuscripts and the Growth of English Law in the Eighteenth Century*. Chapel Hill & London: University of North Carolina Press, 1992, 2 vols. p. 754.

suggestion that the most significant feature of the case was the length, technical breadth and expense of the matters under trial.[218] An earlier analysis however, ascribes to it the descriptor of '*an outstanding example of such a transformation from ill-defined practice to rule of law'* in that judge-made application of the common law to the evolving chronology of inventive advances and paradigmatic vacuum, thereby compensated for the 'timidity of English patent legislation*.'* [219]

A note of caution arises when one looks to the next related advance of this discipline. The specification for Portland cement describes sizing limestone, followed by taking:

> '*a specific quantity of argillaceous earth…and mix…with water to a state approaching impalpability…into a slip pan for evaporation…then I calcine them in a furnace similar to a lime kiln till the carbonic acid is …expelled.*'[220]

Although Bottomley highlights that patent specifications before 1830 enjoyed a 50:50 chance of acceptance before the courts, and argues that intentional submission of a weak specification was tantamount to 'undermining the enforceability of their patent, without cause'[221] this Aspdin example shows a Watt-like reluctance to quantify or even proportion. Strikingly, similar trade reporting of the era seems to accept verbatim this situation.[222] Given ongoing recalcitrance in disclosure, the 1829 Select Committee[223] would have a role to play. One point of note was that the subsequent 1835 Act was more forgiving in that it permitted the amendment of a specification by an inventor who wished to remove errors but only those which would not alter the meaning of the description.

The pattern of case outcomes would, for petitions, have informed the procedures adopted by the receiving Law Officers or, from 1852, the Patent Office,[224] sometimes to exactitude with a suffocating and revenue-realising zeal. In

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[218] Adams, J. N., Averley, G. The Patent Specification: The Role of *Liardet* v *Johnson*, *Journal of Legal History*, 7, 2, 1986, pp. 156-77 at 171.
[219] Meshbesher, T. M. The Role of History in Comparative Patent Law, *Journal of the Patent and Trade Mark Office Society*, 78, 1996, pp. 594-614 at 608.
[220] Aspdin, J. GP 5022 [1824], Artificial Stone.
[221] Bottomley, S. *The British Patent System during the Industrial Revolution 1700-1852: From Privilege to Property*, Cambridge: University Press, 2014, p. 184.
[222] *The Mechanics' Magazine,* 74, 22 Jan. 1825, p. 278.
[223] The report of the Select Committee Appointed to Inquire into the Present State of the Law and Practice Relative to the Granting of Patents for Invention is cited as 3 PP (332) 1829.
[224] Initially, under the supervision of the Commissioners of Patents. The Clerk to the Commissioners became the first Comptroller-General of Patents, Designs and Trade Marks after the 1883 Act (46 &

his entanglements with the Chancery Office's Deputy Chaff-wax, the conclusion of Dickens' famous satire on red-tape was to note:

> '*What I had to tell, I have told. I have wrote it down. I hope its plain…as in the sense of it….if the laws of this country were as honest as they ought to be,…you would have…-registered an exact description and drawing of your invention…and therby have got your Patent*.'[225]

This had had some implications for the early adepts of scientific enquiry, particularly the disciples of Francis Bacon, that 'mouthpiece for society's accumulated practical wisdom'[226] as they sought value in their new-found currency.

Nevertheless, the Liardet case has continued to retain currency with its ripples coming ashore in 1996 in the case of *Markman* v *Westview Instruments Inc.* before the Supreme Court of the United States.[227] In this case Markman brought an infringement suit and the question of whether the interpretation of a patent-claim, being the portion of the document that defines the scope of the patentee's rights, is a matter of law reserved entirely for the court, was affirmed. The Court, having confirmed that '[P]rior to 1790 nothing in the nature of a claim had appeared in British patent practice… '[228] then opined a distillation of the situation pertaining to the era of the Seventh Amendment which was central to its decision in this case, acknowledged that the specification, while just a recent development of that time, was the key to the validity of a patent.[229] It continued:

> '*Thus, patent litigation in that early period was typified by so-called novelty actions, testing whether "any essential part of [the patent had been] disclosed to the public before*"[230] and "*enablement*" *cases in which juries*

47 Vict. c. 57). Subsequent to this legislation the role of the new grade of 'examiner' was to decide patentability and if the invention had been sufficiently well described. Searches, provided for in the 1902 Act (2 Edw. 7 c. 34) were introduced by 1905.

[225] Dickens, C. A Poor Man's Tale of a Patent, *Household Words*, II, 30, 19 Oct. 1850, pp. 73-75 at 75. His reform perspectives on the convoluted bureaucracy are described by Phillips, J. (1984).

[226] Lewalski, B. Eisaman Maus, K. *Forms of Inquiry* in: Greenblatt, S. Abrams, M. H. (eds.) pp. 1550-1605 at 1551.

[227] *Herbert Markman and Positek, Inc.,* v *Westview Instruments, Inc. and Althon Enterprises, Inc.* 517 U.S. 370 (1996); 116 S. Ct. 1384.

[228] *Ibid.,* at 10 citing Lutz, Evolution of the Claims of U.S. Patents, *Journal of the Patent Office Society*, 1938, p. 134.

[229] Dutton, H. I. *The Patent System and Inventive Activity during the Industrial Revolution, 1750-1852*, Manchester: Manchester University Press, 1984, pp. 75-6.

[230] *Huddart* v *Grimshaw* (1803) 1 Web Pat Cas 85 cited in the judgement as Dav Pat Cas 265, 298 (K.B.1803).

were asked to determine whether the specification described the invention well enough to allow members of the appropriate trade to reproduce it.'[231]

While Mansfield has been criticised for vagueness in the way some individuals are addressed as '*others*' in *Liardet* v *Johnson*, Lord Loughborough advanced things in *Arkwright* v *Nightingale*:

'*The clearness of the specification must be according to the subject-matter of it; it is addressed to persons in the profession having skill in the subject, not to men of ignorance, and if it is understood by those whose business leads them to be conversant in such subjects, it is intelligible.* '[232]

Matters continued to evolve and mature quickly. In 1787 the case of *Turner* v *Winter*,[233] before the Court of King's Bench included the following judgment about the sufficiency of patents:

'It is sufficient if persons of skill can understand the process by means of the specification, so as to keep alive the discovery after the patentee's exclusive title is expired. '[234]

The US judgement went on to record that the closest eighteenth century analogue of modern-day claim construction appears to have been the construction of specifications, and 'as to that function the mere smattering of patent cases that we have from this period shows no established jury practice sufficient to support an argument by analogy that today's construction of a claim should be a guaranteed

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[231] *Arkwright* v *Nightingale* (1785) 1 Carp Pat Cas 38, cited in the judgement as Dav Pat Cas 37, 60 (C.P. 1785); also Webster 60.
This case was unusual in that it overlapped with the more substantive *scire facias* action in *Rex* v *Arkwright* {(1785) 1 Web Pat Cas 64; Dav Pat Cas 61; Bull NP 76; 1 Carp Pat Cas 53} and featured stellar witnesses from this chapter, namely James Watt, Samuel More and Erasmus Darwin. Hewish reports that the possible oversight by Chancery officials of the overlap placed Arkwright's patents in a double jeopardy scenario: '*issues of novelty were raised but the defence rested on the specification and judge summed up in its favour. The criterion applied has been used in earlier cases: whether a workman experienced in the 'art' could make the machine from the description. Yet this specification was certainly no example of 'best description' and Arkwright's success surprised the association of Manchester manufacturers and is still somewhat surprising*.' Hewish, J. *Rex* v *Arkwright*, 1785: A Judgment for Patents as Information, *World Patent Information*, 8, 1, 1986, pp. 33-37.
[232] (1778) 1 Carp Pat Cas 50 as cited in http://www.fedcourt.gov.au/publications/judges-speeches/justice-middleton/Middleton-J-20120909.rtf
Accessed: 24 October 2016.
[233] (1787) 99 ER 1274.
[234] (1787) 99 ER 1276.

jury issue…' with none demonstrating that 'the definition of such a term was determined by the jury'.[235]

In a chronological snapshot whereby interpretation by jury might be exercised from earlier in the chapter and which had created a signpost along the pathway to what was later to be a pronounced clamour for published specifications, the aforementioned Sir Philip Howard and Francis Watson, in return for the March 2, 1669 extension to the term of their patent for sheathing hulls,[236] had been requested to:

> '*…enter or cause to be entered in his Majesty's Court of Exchequer*[237] *the said manufacture art or invention within three months….'* [238]

The patentees duly complied[239] and the pattern of these sentiments increasingly became the mould; however as complexity increased, the used of models for more mechanical outputs (and their storage) was to become both increasingly common and contentious. How the properties of the subject matter were to be communicated was to move centre-stage particularly into the nineteenth century, so much so that a new industry, commercial publication of technical journals emerged.[240] Also contributing to the dissemination of knowledge was 'regular, arranged correspondence'[241] or *commerce de lettres* covering experimental research including potentially disclosure of new discoveries.[242] In general terms, public exhibition, evolving from prints and paintings to sculpture to three-dimensional models, would from now become an essential part of the everyday expectation and experience of novelty. Into this brave new world of an

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[235] *Herbert Markman and Positek, Inc.,* v *Westview Instruments, Inc. and Althon Enterprises, Inc.* 517 U.S. 370 (1996) at 11. While Markman relied in evidence that Lord Mansfield in *Arkwright* v *Nightingale* had left matters on the propriety of the Specification to the jury and whether any workman could make [it] by the Specification, the Supreme Court held that it '*could not infer the existence of an established practice.'* Presumably this can be correlated with the novelty of the jury in such cases as the Privy Council had retained jurisdiction in patent cases until 1752.

[236] GB 154 [1667, Oct. 8] Actually 1668.

[237] More usually the trial was before the other common law courts in front of a single judge with a jury: the decision being reviewed by all judges *in banco*. Prior to this an interlocutory injunction had to be sought in the Court of Chancery for the purpose of restraining the defendant(s). If the injunction was successful, the patentee returned to Chancery for a permanent injunction or to have the patent cancelled.

[238] Gomme, p. 32.

[239] Printed in the Official Series of Patent Specifications.

[240] For example, the *Repertory of Arts and Manufactures,* this was published from 1794 until 1862.

[241] Goldgar, A. *Impolite learning: conduct and community in the Republic of Letters, 1680-1750,* New Haven: Yale University Press, 1995, p. 17.

[242] Ellis, M. Thomas Birch's 'Weekly Letter' (1741-66): Correspondence & History in the mid-Eighteenth-century Royal Society, *Notes & Records*, 68, 2014, pp. 261-78 at 262.

increasingly informed public it was altogether inevitable that Mansfield would issue a demand and clarion call for 'specifications' from potential patentees.

The patentee now needed to tread ever more carefully across the slippery surface of experimental philosophy. Shortly afterwards one preliminary opinion in a monopoly judgment in the Court of Common Pleas concerning the exalted Watt and Boulton noted disparagingly: 'the patent appears to be void; …there is no specification descriptive of any formed instrument whatever, nor is there any drawing or model.'[243] Certainly, not least given the prevailing greater awareness of science, it was imperative for the patentee to avoid submitting 'mere principles' with this approach potentially falling foul of the newly prescient Statute of Monopolies: 'the very statement of what a principle is, proves it not to be a ground for a patent: it is the first ground and rule for arts and sciences, or in other words, the elements and rudiments of them.'[244] The empirical approach might have continued with its self-sustaining voyage but a specification-focussed jurisprudence has earmarked it for reining in, a reality that crystallised over the coming decades.

With science now occupying areas of everyday thought and practice and with Britain established as the workshop of the world, the role of communications in fostering the application of scientific method and experiment had indelibly stored exponential improvements in technology. The artificer and the scientist had drawn out a unique synergy with information transfer as the catalyst for this new state of societal advance.

[243] Buller, J. *Boulton and Watt* v *Bull* (1795) 16 May, 126 ER 651; 2 H. BL p. 463; 3 R. R. 439, Davies' Patent Cases, pp. 162-220 at 173-74.
[244] Buller, J. *Ibid.*, at 196.

3.5 Conclusion

Upon the arrival of the nineteenth century Britain's mercantile and technological status were assured, securely tethered to the freedoms conferred by liberation from academic metaphysics through the earlier publications of Gilbert and Bacon, the zeal of perfectionist administrators such as Pepys and entrepreneurs such as Roebuck and Watt. Now founded on accumulated and increasingly secure footprints of technical writings, the wonders of science, early regulatory impositions formalising the legitimacy for remedies' provision, the eruption of communications media, and the excitement of the expanding horizons of empire; was delivered prospects of interest and anticipation that could no longer be curtailed by a selfish secrecy. Feeding on a climate of thought, the enlightened institutions of science saw off the last vestiges of the old regimes and the new mastery of heat and gases propagated an infinite rise of energy and technology.

The fork in the road was mapped by Mansfield in 1778 who in turning the established test for novelty on its head, drew down from the repository of expectations that published technologies had formed and invoked the paradigm that thereafter the instruction of the public was now the role of the patent specification and not the direct function of the grantee. So established, the status of patents, if not their practice, was to fuse into a form of legal tender. While not yet part of the nation's currency they adapted to demands for practical, everyday benefit and created a vista for heightened prospects. The concomitant expansion in industrial output was to sustain Britain through several decades of war augmented by its utter dominance of the seas; a reward for the incremental adaptation of many initiatives, some unintended, which had informed, catalysed and sustained a period of exceptional innovation and economic expansion.

Thesis conclusion

That part of a prospective patentee's submission in which the nature of the invention and the description of the manner in which it is to be performed are disclosed, has had an unnaturally protracted gestation. This thesis terminates at the early nineteenth century and my research sought to establish whence the imperative for the description had emanated from, and how the 'system' had sustained to this point in the absence of apparent requirement for a written description in early English patent law.

By this time materials science was on the cusp of liberation informed by amongst other things, a regularised format of organising the building blocks of nature, the periodic table of the elements. Heretofore, quantitative, compositional description was but part-conjecture, no matter how well drafted. Soon, it would no longer be sustainable for written instruments to play second fiddle to figures, drawings or models. Genesis to this joining together for scientific and civic confidence had been quite interminable but the resultant epigrammatic union was favoured by England's relationship with the tools of knowledge and technology.

There is a need for additional research to address the question of whether the collectivist nature of a medieval society militated against the intellectual *milieu* demanded by inventiveness and any attached requirement to disclose the valuable, specialised functionality of a technology. This was especially true in the outlying kingdom of England; yet this society nevertheless evolved sporadic awards of exclusivity in trades where a dearth of capability could potentially afflict the harmony or fiscal stability of the country. That there was no shortage of aspiring immigrants has been shown by the repeatability of petitions for entry and diffusion of aliens throughout the country. In the meantime, London's apprentices faced numerous obstacles in a quest for their ultimate freedom, one being increased educational attainment and a further prerequisite, of older age on entry to indentureship. Once through this loop, the history of the era researched in this thesis confirms that there remained inconsistency of instruction and opportunity. Yet while the State had seen fit to enact centralised labour control as personified in the Statute of Artificers,[1] I have shown that it had however perceived no ongoing need to invoke a formal system to attract and fix the innovative capacity or attributes of the skilled itinerant artisan. A key factor was the activity of the newly

[1] 5 Eliz. I. c. 4 (1563).

emancipated surgeon and their increasing scope for forging personal initiative and then taking the time to write about their innovative interventions and bodily incisions. It was in less hirsute medical writing that the vernacular was both trigger and cultivar for descriptions of elements of art-of-touch. Promotional yet profound, such interventions, sometimes local, sometimes Italian imports, were not at first recognised for their worth, yet their legacy continued to find expression as surgical processes not restricted in the inertia of tradition. Here too, far from an improvident meddling, and thanks to their proximity to the seat of power and influence, some members of the medically educated obeyed their impulses of curiosity and softened the landing for other written formats of utilitarian activities. Neither interdependent at first, nor separate realms of knowledge as later, now each of history, literature, science and even illustration[2] combined with craft and carved their inerrant alignments with the mnemonics of intellect. Under these, almost exclusively individualist horizons, Government planned for much of everyday life, but in terms of stimulating invention it was happy to be reactive. The strongest evidence for this had been provided through the observation of Sir John Fortescue CJ whose outline of the avenues of royal patronage singularly omits the route of patents as a system and the perspective that 'causeth lords to rule at neede.'

Indeed, at the dawn of the furore around monopolies *circa* 1603, the levers of oversight within London's higher handicrafts' guilds were firmly in the hands of the court of aldermen. The implication was that audit of standards had increasingly been assigned to non-craftsmen. Sharp practice in the form of: 'deceipt as [is] daily practised by lewde persons…and others…which…falcehood the best experience can hardly be able to discover'[3] was to the disadvantage of the master craftsman. This was the era of commercial abuses and the technology imbroglio was such that a craft could not excel in such a lapsed or contradictory environment. This was the final phase in the development where 'ownership of shop sites' was more important than 'ownership of tools'.[4] The deficit in social cohesion must have been apparent yet vested interests prevailed in the ensuing technological vacuum. Despite promptings towards self-sufficiency and export, and policy successes in

[2] Clanchy, p. 85.
[3] Ashton, p. 53 citing SPD Jac. I. CLXIII/10, CXVIII/119.
[4] *Ibid.*, p. 52.

fostering new commercial opportunities, there remained an insufficiency capable of sustaining a plateau of activation for indigenous knowledge transfer.

Concessions were afforded to master craftsmen but the concept certainly failed to sustain not least by virtue of the lobbying of those undeserving sorts who happened to be well-connected, and the fiscal needs of the Crown. Future researchers may confirm that longstanding shibboleths remained true for early innovations certain to benefit the ruled (e.g. extractive processes such as facilitating the provision of salt) and the rulers (some seeking a legacy through the visual vocabulary of decorative glass). It was not until the mid-sixteen hundreds that the processes, possibly informed by events of the previous century, but initially not any more mature, re-emerged for immigrant artisans but were soon replicated enthusiastically for native entrepreneurs. It has been argued here that the missing link was the necessity to erode the seam of subjugation heretofore sheathed over the trades from artificers down to apprentices; for there remained the absence of expectation that the efficient transfer of technology demanded a policy of promulgation of a written description.

The question of the liberation of this intangible knowledge and its transfection into a new body politic of individual authorship was initiated with collective ownership of skills continuing to fray at the edges into the reign of Henry VII where it interfaced with the centralised authority imparted via statutes regulating grants through implementation of robust processes.[5] The necessity to avoid duplicate grants was moot, yet the legislative principles were not founded upon a marriage of traceability for the first patentee, or of discrimination for a second letters patent on the basis of a written description incorporated into a petition or pleading.

Having absorbed key religious refugees England, abetted by demand for faith-based outputs, now combined the catalytic nurturing of the printing press to cement the cultural ground-zero of parliamentary supervision of a divinely appointed monarch, the executive font of the Great Seal. So even though it was not the first to recognise the value of fostering a new method of elevating the means of working *with* technologies and securing these with the enticement of time-limited

[5] For instance: 18 Hen. VI. c. 1 (For regulating Grants by the King); 6 Hen. VIII. c. 15 (An Act avoiding second letters patent granted by the King) and; 27 Hen. VIII. c. 11 (An Act concerning Clerks of the Signet and Privy Seal(s).

privileges, these ideas had now arrived, migrating from adjacent societies with those deemed misfits by ecclesiastical zealots or through economic imperatives. The thesis extends this idea: the era's treatises on mathematics, engineering and medicine serve as valuable metaphors for early efforts to derive practical benefit from attempts to master nature. A point of convergence for the thesis, it now reinforces the relationship between mind, hand and increased access to higher quality printed authorship, yet the scholastics behind such tracts and representations remained acutely aware of the commercial penalty to the individual of unfettered leakage of technique. It would now be over to rulers to create equilibrium for a balanced stimulation of inventive activity.

As interrogated in Chapter 2, from the mid sixteenth-century an eruption of ideas flourished, as increased education, expectation, population, and trade-inspired affluence, all fertilised demands for old and new staples. In terms of technological advance however, the absence of the lucidity donated by the submission of a written description by an applicant for a patent ultimately facilitated the temptation into which the financially restrained and ultimately incontinent Stuarts, succumbed. Subject to the asphyxiation of monopoly abuse for routine artefacts of life, the clamour of the ruled, focussed through their increasingly articulate representation in the Commons, laid a track to the Statute of Monopolies which, with its exceptions including that for inventions, provided cover for a newer form of industrial effort. Still absent was the routine enrolment of a specification but the thesis integrates several strands confirming that such mapping of the contours of inventive space was, under the inspiration of luminaries like Neri, Bourne and Wheler becoming increasingly possible, not just to record, but to become a syllabus for dissemination of technical advancement.

Individual elements of the thesis now become united as the shredding of residual consequences of a 'generally inconvenient' guild-inspired secrecy concluded. Now required was a demand-driven response as indicated by the reaction to the trailblazing Sturtevant who, although circumscribed himself, enrolled a new paradigm for the provision of the patent specification.

The final element of the consummation for the requirement to provide an appropriate written description for inventions was the parallel advances of the scientific societies. Chapter 3 constructs how there was initiated during the Restoration era, a definition of a new direction, one requiring the re-evaluation of

prior facts and incremental momentum to new fundamental principles not necessarily compatible with the desire of the historian to attempt to use their lexicography to define precise dating of events. Inventions of theory are less prone to delineation than physical variables and so adjunct amalgams also sprung up both within and outside of London with a more nuanced, practical focus on improving the elements of everyday life.

Each required a medium; the Royal Society chose the written instrument of the scientific journal, others derived their *raison d'être* from inspiring more practical endeavours through the increased diffusion of specialist periodicals. There was now an irrevocable cycle of peer review and citation; a cumulative, documented repository of meaning for a new culture of technological, industrial, agricultural and naval advances. Oral communication would continue to have its place but the nexus of the architecture of a specification, the written description was, from 1711 on an increasingly robust foundation. On foot of a request from the Law Officer, what is thought to be the first detailed description of a patent for invention was lodged within six months of grant by (fittingly) apothecary John Nasmith in respect of his sugar patent.[6] Nasmith requested the delay so as to protect his secret. Such a deposition became standard in the subsequent decades and was rendered yet more solid later in the century by the action *Liardet v Johnson*[7] and continued to become evermore comprehensive. Prior to this application, there were but inadequate descriptions of the workings of the inventions; now a new Rubicon had been inaugurated.

Before there could be such a satisfactory description of the era's stupendous leaps forward, the essential requirement was that there be a written medium established upon a vernacular expression; an evolution that was auto-catalytic as the earlier reliance of craftwork on in-house oral literature became anachronistic. The public could now be invited to the exhibition and decide the extent to which they might participate.

[6] GB 387 [1711].
[7] Bull NP 76; 1 Web Pat Cas 53; 1 Carp Pat Cas 35.

Appendices

Appendix I

Table of cases

Alton Woods, Case of (1600) 76 ER 89, 1 Co Rep 40b

Arkwright v *Nightingale* (1785) 1 Carp Pat Cas 38; Dav Pat Cas 37; 1 Web Pat Cas 60; 1 HPC 221

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D'Arcy v *Myriad Genetics Inc* [2014] FCAFC 115 (5 September 2014)

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14 & 15 Hen. VIII. c. 1 (1523) Cloths: The Act concerning the conveying, transporting and carrying of Broad White Woollen Cloths out of this Realm (*Country Weavers not to deal with Foreigners*)
26 Hen. VIII. c. 1 (1534) Supremacy of the Crown: An Act concerning the King's Highness to be Supreme Head of the Church of England, and to have Authority to reform and redress all Errors, Heresies and Abuses in the same
27 Hen. VIII. c. 2 (1535) An Act Concerning the Forging of the King's Sign Manual, Signet, and Privy Seal. "The Forging of the King's Sign Manual, Privy Signet or Privy Seal, declared High Treason."
27 Hen. VIII. c. 11 (1535) An Act concerning Clerks of the Signet and Privy Seal
32 Hen. VIII. c. 40 (1540) Concerning Phisicians & their privilege: Apothecaries, Search of Wares of
34 & 35 Hen. VIII. c. 1 (1542) An Act for the Advancement of true Religion, and for the Abolishment of the contrarie
35 Hen. VIII. c. 17 (1543) An Act for the preservation of Woods

1 Mariæ, Stat. 2, c. 9 §3 (1553) An Acte touching thincorporations of the Phisitions in London; Wardens of Grocers shall assist in searching Apothecaries' Drugs

5 Eliz. I. c. 4 (1563) Statute of Artificers.
35 Eliz. I. c. 2 (1592) An Acte for the Restreyning of Recusantes to Some Certen Places of Aboade

1 Jac. I. c. 19 (1603-04) An Acte for the well garbling of Spices
21 Jac. I. c. 3 (1624) Statute of Monopolies.

Commonwealth Act AD 1651, c. 2. Act concerning the new Invention of melting down Iron and other metals with stone-coal and other coals, without charking thereof.

22 & 23 Car. II c. 7 (1670) Granting Sir Philip Howard and Francis Watson sole use of an invention for the benefit of shipping. Private Act.

10 Will. III c. 31 (1698). Encouraging Thomas Savery's invention for raising water and relating to all sorts of mill work. Private Act.

8 Anne c. 19 (1710). An Act for the Encouragement of Learning, by Vesting the Copies of Printed Books in the Authors or Purchasers of Such Copies, During the Times Therein Mentioned' (the 'Statute of Anne)

15 Geo. III. c. 61 (1775) An Act for vesting in James Watt…the sole Use & Property of certain Steam Engines…of his Invention, described in the said Act, throughout His Majesty's Dominions for a limited Time

5 & 6 Wm. IV. c. 83 (1835) An Act to Amend the Law Touching Letters Patent for Inventions.

14 & 15 Vict. c. 82 (1851) An Act to simplify the forms of appointment to certain offices and the manner of passing grants under the Great Seal
15 & 16 Vict. c. 83 (1852). An Act for Amending the Law for Granting Patents for Inventions (1852 Patent Law Amendment Act)
46 & 47 Vict. c. 57 (1883) Patents, Designs and Trade Marks Act
50 & 51 Vict. c. 59 (1887) Statute Law Revision Act

Patents Act. 2 Edw. 7 c. 34 (1902)

Patents and Designs Act. 7 Edw. 7 c. 29 (1907)

Patents Act 1977

European Patent Convention (EPC) (1973, revised 2000) Art. 52, Art. 56, Art. 84

35 USC §103

Intellectual Property Laws Amendment (Raising the Bar) Act [2012] (Australia)